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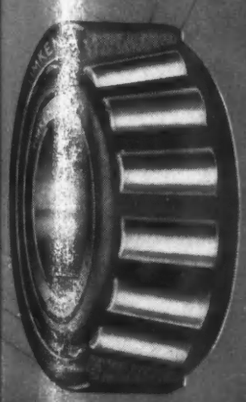

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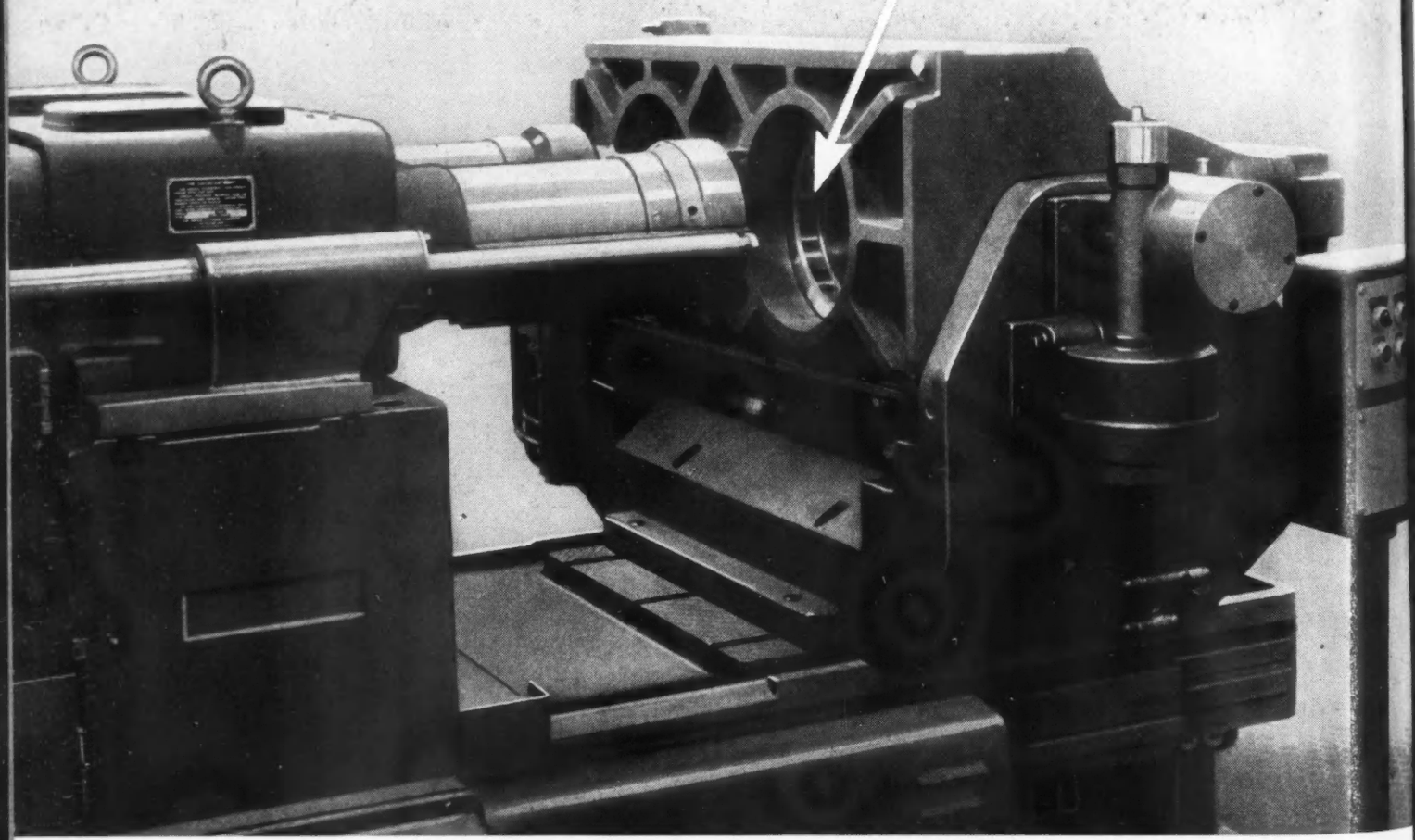

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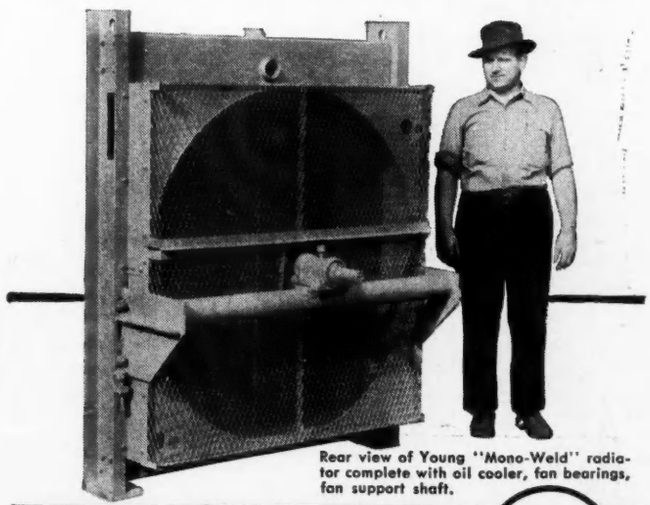

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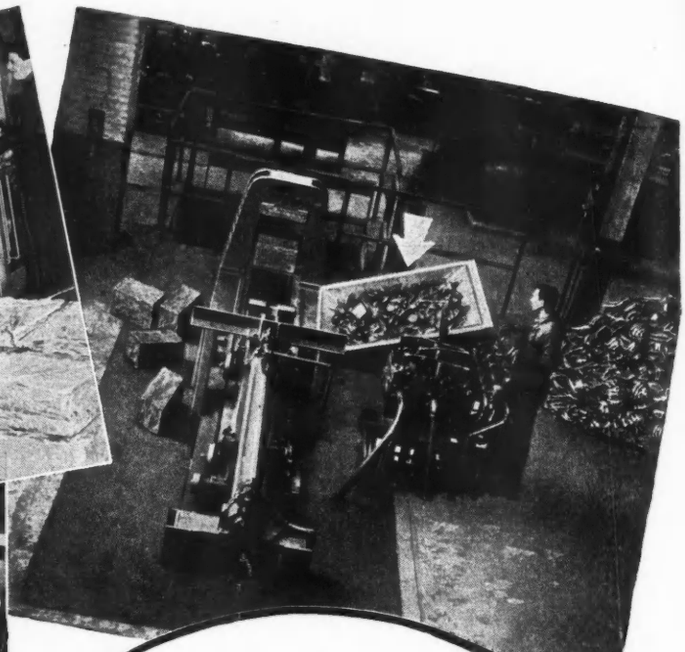

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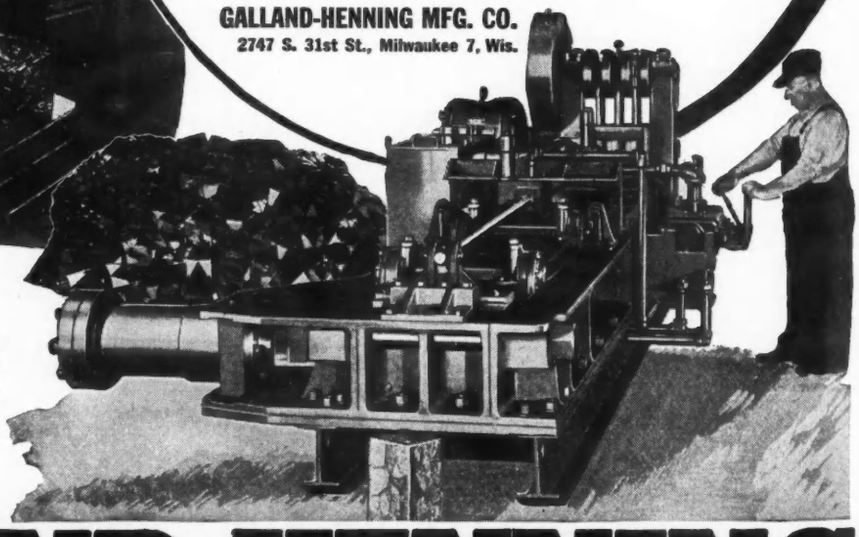

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Which Way, Americans?

By Ernest T. Weir

IT IS characteristic of governments, when they make mistakes with power they already have, to attempt to correct the mistakes by securing new and larger powers. With these they then proceed to make new and larger mistakes. The Founders of our country clearly understood this trait of governments. That is why they made the individual citizen the chief repository of power, and strictly limited and defined the powers to be entrusted to government.

For the past 13 years, the dominant feature of our national life has been a steady reduction of the power and freedom of individuals and a proportionate increase in the power and authority of Government. We have been moved away from government based on the American principle of individual freedom and responsibility. We have not yet reached government based on the European principle of state control. In this circumstance, we find the explanation for much of our national confusion. The issue that confronts the American people today is the decision as to the type of government they want.

Many good Americans do not believe that a fundamental change has been brought about in the American system. They scoff at the idea that the innovations of recent years can make any great difference in the way Americans live, can limit the freedom of the individual, or can depress standards of living. That is because the issue of the American system versus the European system has never been submitted to them directly or in its entirety. The change has been produced piecemeal. And it did not just happen that way.

The small but clever and energetic radical minority that wants a state-controlled America knew well that the vast majority of Americans would promptly and violently reject state control if it were openly and honestly presented. So that minority, working inside and outside of government, moved toward its objective by separate steps. Each step was offered to achieve some so-called social or economic gain, which was the basis on which it was accepted by the public. But each step also extended and increased the authority of government while it limited the freedom of the individual. These steps fit into a pattern. It is a pattern of social revolution. It has been in progress for years. It has moved us closer than most people realize to the radical objective of state control.

This change first occurred when some of our people repudiated the American principle that each individual's success or failure in life is the responsibility of that individual. In their minds, that principle was replaced with a principle of radical philosophy, namely, that the individual's success or failure is not his responsibility but that of the system under which he lives. Under the first principle, rewards come from the individual's own work and are in proportion to the value of his work. It encourages the individual to put maximum effort into his work. Under the second principle, rewards depend upon the system. It encourages the individual to devote his energies to political action designed to make the system give him more for less work.

(*Turn to page* 104, *please*)

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Heavy Production Losses Caused by Parts Shortages and the Coal Strike

Strikes at Suppliers' Plants Continue and Outlook for Labor Peace Dark; Attack on Incentive Wage Plans by Unions Appears Impending

By Leonard Westrate

ALTHOUGH automobile production figures showed an encouraging upward trend during the month of April, going into May the outlook was particularly dark with the coal strike, still to have its full effect as this is written, added to other deterents. The large increase in April was due much more to the resumption of General Motors and Packard production lines than to any improvement in the supply of parts, which currently is the greatest brake on output. That is apparent from a study of production figures of such companies as Ford and Nash, both of which have been building cars for several months.

Weekly production figures at Nash for April tell an illuminating story. They are: first week—2594; second week — 2676; third week — 2455; fourth week—1800 (a short week), and last two days of April—1023. Daily figures for the first week averaged 519 cars. Production on April 30 was exactly the same number. This situation is due to the difficulty automobile companies are having to get sufficient supplies to maintain levels prevailing several weeks ago, to say nothing of increasing schedules.

Ford has had a more difficult problem, which is logical in view of the greater overall production. At the end of March, production was running about 3400 vehicles a day. During the four weeks of April output per day in round figures was 3300, 3400, 3200, and down to 2800 by the end of the month. Production was seriously hampered by supplier strikes, with as many as 36 sources shut down at one time. Following is a list of Ford Motor Co. parts affected by strikes as of April 30: Production and service light bulbs; tractor castings; starter switch and contact eyelet; brass for radiators, generators, and starting motors; flexible tubing for buses; transmission gears and cylinder heads; glass run assembly; castings for pedal brackets and rear spring shackle brackets; truck front and rear and auxiliary spring assembly; cushion springs for Ford and Lincoln cars; mechanical rubber goods; starter and generator carbon brushes; bus engine piston rings; truck clutch pressure plate castings; bell housing cover and rear case castings for bus transmission; brass pipe fittings; sidewall and body cloth for Lincoln; certain equipment for operating open hearth; bolts, screws, nuts, and rivets; radiator filler necks for Fords; washers and sockets for Lincoln; all seat springs for Long Beach branch; two-speed truck axles; instrument cluster glass; shock-absorber ball stud; steering sector shaft; stabilator shaft assembly for Lincoln; ball bearings, spindles; impact bars and hangers for all cars; bumpers; fender shields; air cleaners; brake levers, and ignition locks. The list changes from day to day as one company settles its difficulties and another closes. Ford could have managed to keep going by using alternate sources, had not the coal strike interfered. While no official production figures are available from Chrysler Corp., estimates of output for the first week in April set the total at about 15,000 units for all divisions. Production for the last week of that month has been estimated at approximately 15,900, a net gain of fewer than 1000 cars a week for the 30-day period. On the basis of showings by Ford, Nash, and Chrysler, it is

(*Turn to page* 96, *please*)

Automobile Developments

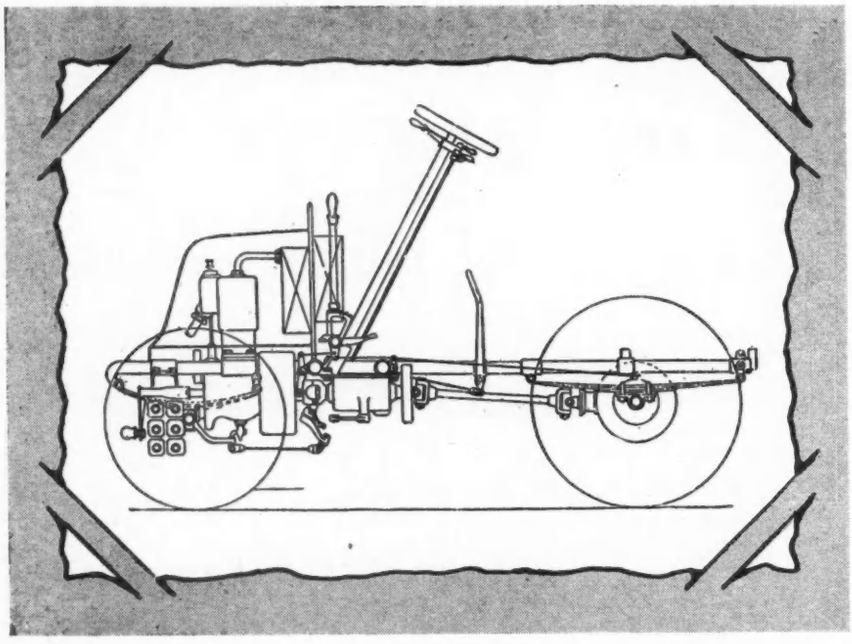


Fig. 1—Darracq chassis with steering column mounted gearshift lever.

IN THE course of automobile development it has happened repeatedly that new features were introduced which later had to be abandoned temporarily, either because the general state of the art was not sufficiently far advanced, or because the particular design was immature. Attention was called to this matter by Henry M. Crane, in a talk given before the Metropolitan Section of the SAE last winter, in which he gave a general review of developments in passenger-car engineering since the beginning of the century.

Perhaps the most outstanding example is that of the gearshift lever mounted on the steering column, a feature which came back into general use on passenger cars about a decade ago. Its origin dates back to the years 1900-03 when there were a number of cars of both foreign and domestic manufacture so equipped. Among the earliest ones were the De Dion, Marot-Gardon and Darracq, made in France, and the Peerless Motorette and Ward Leonard made in America. These cars were of the vintages of 1900, 1901 and 1902. A side elevation of the Darracq, reproduced from *The Horseless Age* of Dec. 26, 1900, is shown in Fig. 1.

The George N. Pierce Co. of Buffalo, forerunner of the Pierce Arrow Motor Car Co., adopted this type of gearshift when it marketed its first car with front-mounted engine in 1903. Like most other cars of the period, it was an open model and had hight-hand control. In such cars the gearshift and brake levers normally were located outside the body at the driver's side. Just what prompted the Pierce company to depart from conventional practice is not definitely known, but the probable reason is that a shift lever outside the car would have interfered with entrance to the driver's seat. Another reason may have been that, since the transmission was of the "progressive" type and its single sliding member had to move about 5½ in. from the reverse to the forward high-speed position, a lever sufficiently long to be within convenient reach of the driver would have had a very long range of motion, and would have been awkward to operate.

The column-mounted shift lever was continued by Pierce for at least another year, and appeared also on the "Great Arrow," marketed in 1904, of which a photograph is shown in Fig. 2. The shift lever on this car was very short; in fact, little more than a handle. It does not require great erudition to figure out the reason for the abandonment of this feature in later models. Although the car carried an engine of only 15 hp, its transmission was larger than any now carried on a passenger car. Owing to the great range of motion of its single sliding member, 5½ in., and the very short shift lever, it was impossible to get a good mechanical advantage, and on a really cold morning it must have been next to impossible to make shifts with the steering column mounted lever. Another thing that must be taken into consideration in this connection is that the synchromesh transmission had not yet been invented, and when it took practically all the strength of the driver to make a shift, it must have been extra difficult to avoid severe clashing.

The next introduction of the column-mounted shift lever followed that of the synchromesh transmission. By that time, also, left-hand control had become general, and the great majority of cars produced were of the closed type. The conventional practice had been to place the gearshift and hand brake lever in the middle of the driver's compartment, where they were very much in the way. By mounting the shift lever on the steering column and the brake lever on the cowl, the compartment was "cleaned up."

Another example of an early development that was

that Came Too Soon

By P. M. Heldt

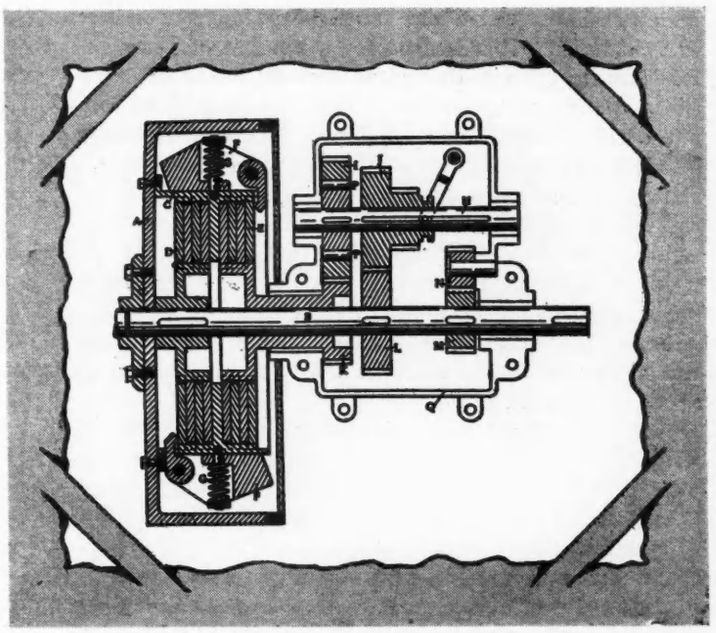


Fig. 3—Automatic transmission of Sturtevant Brothers 1904 car.

later eclipsed for many years was the automatic transmission. What was undoubtedly the first transmission of this type in this country was fitted to the Sturtevant Brothers car brought out in Boston in 1904. A sectional assembly view of this transmission is shown in Fig. 3. Use was made of a principle that was later embodied in the automatic overdrive, viz., that if a one-way clutch is introduced in one member of the low-gear train, then the high-gear train or direct drive may be engaged without disengaging the former, as the roller clutch allows it to overrun or idle. As shown by the drawing, the Sturtevant transmission comprised two friction clutches, enclosed in the same housing, which were engaged automatically by means of centrifugal masses carried by the flywheel. With the engine idling, both clutches were disengaged by the springs which held the centrifugal masses in their innermost positions. When the throttle was then opened and the engine speeded up, clutch E was engaged first, because its spring was weaker than that of the other. Power was then transmitted through the gear train K,I,J,L, which gave the low forward speed. As engine speed increased further, the centrifugal force on the other mass overcame its spring, and that clutch also engaged. The driven member of that clutch was mounted directly on the output shaft of the transmission, to which it was keyed, and this therefore, gave a direct drive. Clutch E remained engaged, but that had no ill effect, as the roller ratchets P,P allowed gear I to run ahead of its center.

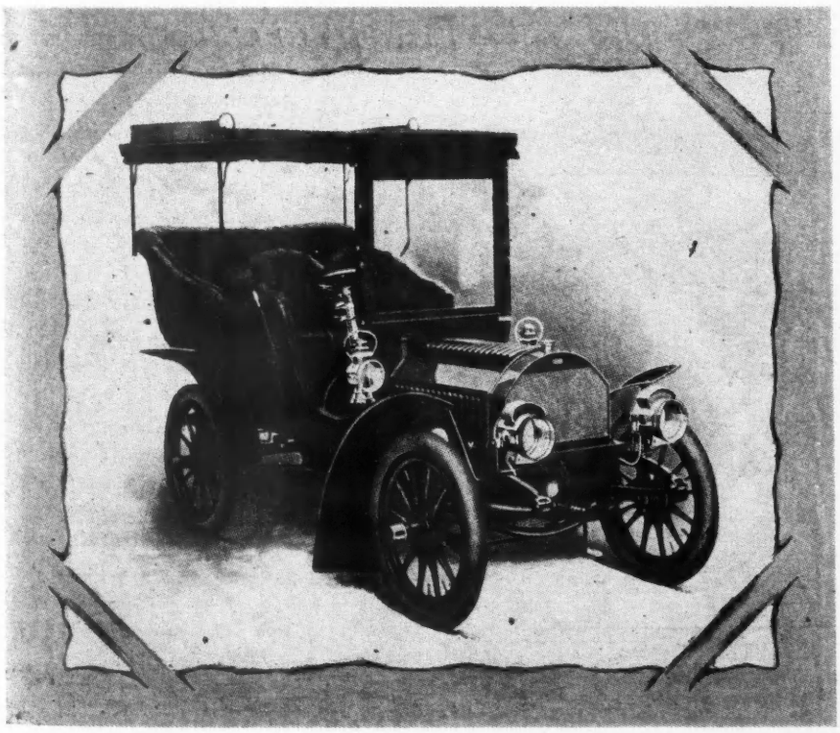


Fig. 2—Photograph of the 1904 Great Arrow which embodied the same feature.

The Sturtevant firm did not survive very long in the automobile industry, but whether its unsuccess was in any way due to

shortcomings of this automatic transmission is not recorded in automobile history. That the transmission had shortcomings there can be no doubt, for aside from the fact that it had only two forward speeds, at any given speed it was possible to drive in one particular gear only. In other words, the driver was not able to "override" the automatic feature.

The same deficiency was inherent in an automatic transmission brought out much later, by Reo in the early thirties. It was used for a number of years on Reo passenger cars, the original model being succeeded by an improved version. That, however, also was not entirely satisfactory and was finally abandoned. The Reo was essentially a four-speed transmission, consisting of two gearsets arranged in series. Each of the two gearsets had two ratios, a direct drive being combined with a gear reduction in each. Under all ordinary driving conditions one of these gearsets, which had hand control, remained in direct drive, while shifting of the other was effected automatically. With this transmission the shift from low to high occurred at about 14 mph.

A further step forward in automatic transmissions was the Warner automatic overdrive, which was developed by Warner Gear Division of Borg-Warner Corporation and adopted as special equipment by Chrysler in 1934. This is essentially a two-speed auxiliary transmission, and with it the driver can remain in direct drive longer than up to the speed at which the shift into overdrive normally occurs, if he so desires. Finally, in 1939, General Motors came out with its Hydramatic transmission.

Freewheeling Units

Another instance where a new feature was introduced in automobile practice ahead of its time, or before it had been properly worked out, occurred in 1906, when the Haynes Automobile Co. produced a car embodying a freewheeling feature in the transmission. It was undoubtedly suggested by the coaster brake, with which all bicycles were equipped at the time. The same as the coaster brake enabled the cyclist to coast down hill without pedaling, so the freewheeling device enabled the motorist to coast with his engine idling at low speed. In the Haynes transmission, illustrated in Fig. 4, the driven member F of the first-reduction or constant-mesh gears had a three-prong ratchet fitted into it, which allowed the car to coast when in either intermediate or low gear. This, of course, resulted in a certain saving of fuel. Besides, the device relieved the transmission gear and final drive of excessive stresses in the event the driver shifted from a higher to a lower gear and then engaged the clutch without first allowing the car to slow down sufficiently.

A disadvantage inherent in the device was that it made it impossible to use the engine as a brake in intermediate or low speed, so that an important safety feature of the automobile was sacrificed. In addition, since the freewheeling unit was not of the roller ratchet, but of the pawl-and-ratchet type, there may have been considerable slack in it, which would have shortened its life. At any rate, it was abandoned again the next year. When the freewheeling feature later became quite popular for a number of years, the unit was always provided with a lockout, so that it could be rendered inoperative when driving conditions were more or less hazardous. The Haynes unit had no lock-out.

Independent Suspension

Many years elapsed between the time when independent front suspension was first applied to a car and the time when it first became a regular feature of cars in quantity production. The first car to have it was the French Sizaire-Naudin of 1904. A drawing of the frame front cross member and the single cross spring of this car is shown in Fig. 5. The steering knuckles have long vertical cylindrical members which extend through vertical holes in bosses at the ends of the frame cross member that takes the place of the conventional front axle. A cross spring mounted on top of the frame bears with its ends against the vertical members of the steering knuckles and thus controls their positions relative to the frame.

At present front-wheel independent suspension is used mainly because it permits of guiding the front wheels positively,

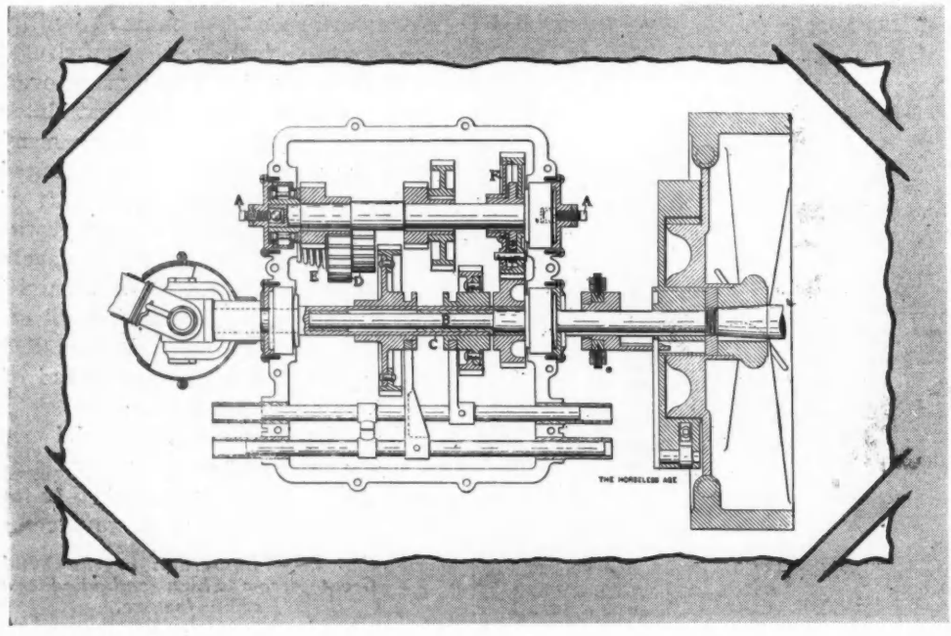


Fig. 4 — Transmission of Haynes 1906 car with freewheeling feature.

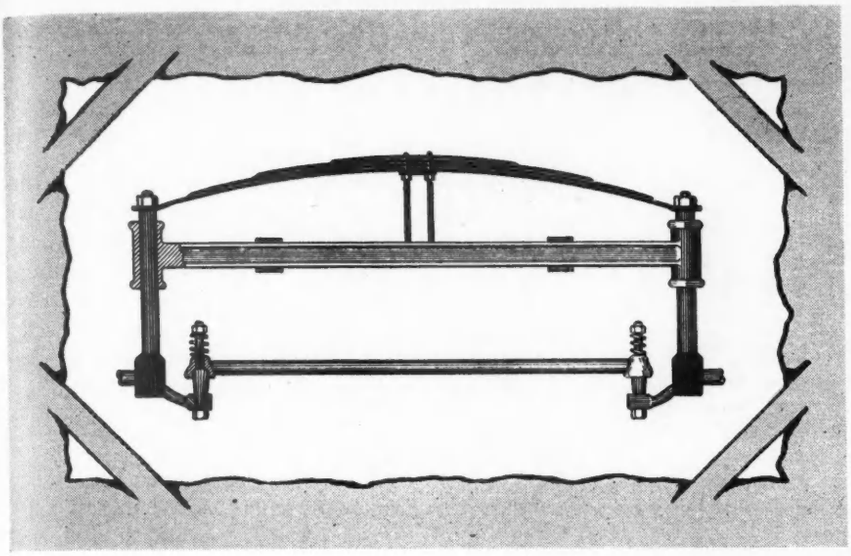


Fig. 5—Sizaire-Naudin 1904 front independent suspension.

and this in turn permits of making the front springs much softer, thereby ensuring a more comfortable ride. If the steering wheels are not thus guided, the steering control is likely to be erratic. In the Sizaire the front wheels were restrained to a straight up-and-down path. They were therefore guided positively, and the spring could have been made quite soft without fear of impairing the steering qualities. In the writer's opinion, however, it is very doubtful whether the designers of the Sizaire were aware of this possibility and took advantage of it. What they were aiming at most was a design that permitted of low production cost, and the single cross spring, the simple form of the steering knuckles, and elimination of the front axle all tended in this direction.

Apparently the real merits of front independent suspension were first recognized by Lancia in Italy about 1922. He used a construction which in principle was similar to that of the Sizaire, the knuckles sliding in vertical guides secured to the car frame, but double coil springs were used instead of a single plate spring; all moving parts were completely enclosed, so they could be properly lubricated, and shock absorbers of the hydraulic type were built into the suspension.

In this country a car with independent suspension all around was produced by Parenti in Buffalo around 1920. Suspension was by superposed semi-elliptic transverse springs at front and rear, to the ends of which the steering heads or knuckle supports were secured. This car did not pass the promotion stage. The chief object aimed at with this suspension was a reduction in the unsprung weight, which always has a favorable effect on passenger comfort.

The beneficial effects were demonstrated by driving the car over curb stones and other obstacles, which could be done without severely jolting the passengers.

A great many different designs of independent suspension originated in Europe between the end of World War I and 1930, but most of them were very crude and unsightly. About 1930 a number of more practical designs made their appearance. In 1934 front independent suspension was adopted by both Chrysler and General Motors and its use has since been greatly extended in the passenger-car field.

Four-Wheel Brakes

All of the earlier cars had brakes that acted only on the driving wheels. With the relatively low maximum speeds of that period and the low traffic density, two-wheel braking was quite sufficient for all practical purposes. As driving speeds increased the advantages of brakes acting on all four wheels became apparent, but the design of brakes applied to the

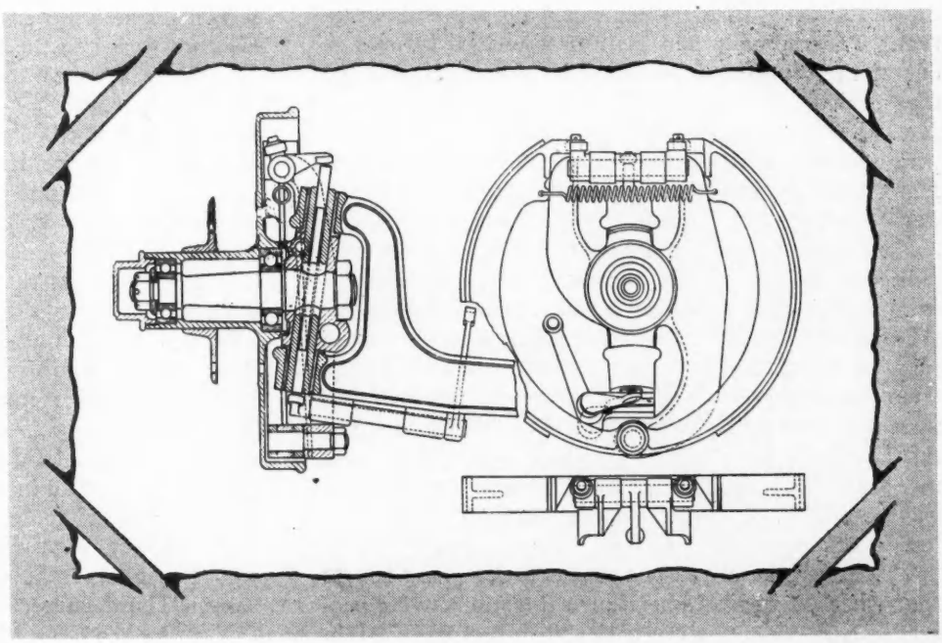


Fig. 6—Scat front-wheel brake of 1910 (pioneer four-wheel brake).

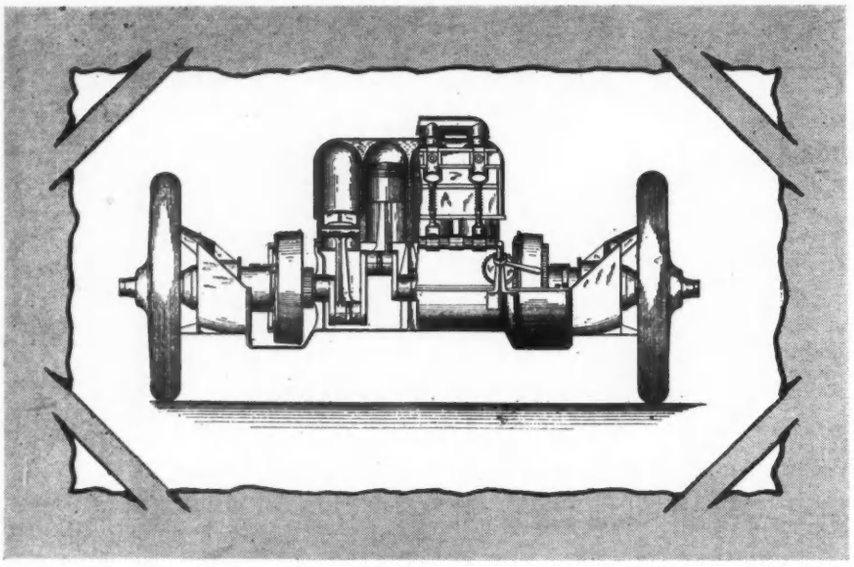


Fig. 7—Walter Christie 1904 front-wheel drive.

steering wheels involved a number of rather difficult problems. Front-wheel brakes appeared on a French truck, the Dufour, as far back as 1904, and in this country a front-wheel brake was patented in 1907. The Dufour design, however, was considered impractical for high-speed vehicles, because the retarding force acting on the tire tread had a rather long moment arm around the knuckle pin, which might have produced unfortunate results if, while the brakes were applied, one of the front wheels had gotten onto slippery pavement while the other remained on dry pavement with a high coefficient of adhesion. The early American design also saw no commercial application. A number of improved constructions appeared in Europe in 1909 and 1910 and marked the real beginning of the four-wheel-brake movement. One of these brakes, which was fitted to the Italian Scat car in 1910, is shown in Fig. 6.

Four-wheel brakes, of course, were needed most in racing, and especially in road racing on courses with numerous sharp turns, which called for rapid deceleration. They actually had their first serious tryouts in one of the big international road races which marked that period. One of the most successful pioneers of four-wheel brakes was Henri Perrot, a Frenchman who held the position of chief engineer of the Argyll Motor Car Co. in Scotland. Perrot's American patents were acquired by Vincent Bendix, and formed the nucleus around which the Bendix brake business was built up. While most of the early four-wheel brakes were applied by mechanical means, Malcolm Lougheed, a California inventor, developed a brake in which the force of application is transmitted by hydraulic means from the pedal to the brake on the wheel. These brakes were first used by Duesenberg in 1921. A license under the Lougheed patents was acquired by Chrysler, and the brake was applied to the Chrysler car when it was launched in 1924. Buick adopted four-wheel brakes of the mechanical type the same year.

There are several reasons why it took so long before four-wheel brakes became standard equipment on passenger cars after their practicability had been established on racing vehicles. One is that traffic conditions in most districts were still such that these brakes—which, of course, added considerably to the cost of production — were not really needed. Besides, it was feared that application of brakes to the steering wheels might interfere with steering and introduce hazards more serious than those which would be eliminated by the provision of more powerful braking equipment. A number of warnings were issued in the press at the time not to fit four-wheel brakes hastily, and when one of the large makers announced the adoption of such brakes, a competitor countered by issuing the statement that his cars would carry them as soon as they had reached a practical stage. Actually there was a period during which interest in four-wheel brakes had practically vanished. In England quite a business in fitting such brakes to cars already in service was developed during the first years of the second decade. But some of the installations proved unreliable and the business petered out. Then followed World War I, during which there was no further development along this line abroad.

All-Metal Bodies

Almost all of the early cars had open bodies built entirely of wood by carriage builders. Chassis engineers, of course, were much more familiar with metal construction, and certain advantages offered by all-metal bodies appealed to them from the start. The question has often been asked, "Who built the first all-metal body?" I do not know whether this question has ever been answered to the satisfaction of everyone. However, it is a matter of record that back in 1899 the Springfield (Mass.) Cornice Works, later the Springfield Metal Body Co., made automobile bodies of steel with wood sills for Hinsdale Smith who pioneered in automobile building. Mr. Smith exhibited two cars fitted with bodies of that type at the first automobile show which was held in Madison Square Garden in January, 1900. At the 1901 show, Mr. Smith exhibited a car with full metal body.

When the Stevens-Duryea Co. commenced operations, which according to available records was in 1902, it bought metal bodies—aluminum instead of steel to save weight—from what was soon to become the Springfield Metal Body Co. Aluminum was also used by Springfield in the manufacture of closed bodies with solid metal roofs considerably before other types of metal roofs appeared. As described by Mr. Smith, who was one of the owners of the Springfield company, "These curved and rounded roofs were made

(*Turn to page* 82, *please*)

Airbriefs

By Robert McLarren

Exhaust Turbines

Fuel savings as high as 40 per cent and power increases as high as 30 per cent have been achieved through wartime research in aircraft engine exhaust gas utilization. NACA's Aircraft Engine Research Laboratory at Cleveland, Ohio, has released data on tests of six different systems: individual jet stacks, collector ring and nozzle, geared steady-flow turbine, geared blowdown turbine and a combination blowdown and steady-flow turbine system, the last proving the lightest, most powerful and most economical installation. Basis of the investigation was the fact that as high as 30 per cent of the available energy in an internal combustion engine is lost through the exhaust.

The use of this energy to drive a turbosupercharger has reached a high state of development during the war but analyses reveal that considerably more power is available from this unit than is actually used to provide air compression. The NACA-AERL investigation was directed towards the gearing of this turbine directly to the engine. The reports reveal for the first time that straight jet exhaust stacks provide 16 per cent additional power to conventional aircraft engines. Their excessive noise, however, renders their use on transport planes impractical. By directing the exhaust into a manifold and thence through a single jet, the noise is reduced considerably but the back-pressure created in the exhaust manifold seriously impairs engine power. Next step was to direct these exhaust gases against a steady-flow turbine (as in the turbosupercharger), but gearing the latter directly to the engine. Tests proved that this turbine arrangement remains well-matched with the engine at all altitudes from sea level to 30,000 ft.

Another step was the use of individual stacks directly to the turbine, resulting in the "blowdown" system, which reduces exhaust back-pressure to a minimum. This system proved superior at sea level but its performance fell off with altitude as compared to the steady-flow turbine. Final arrangement was a combination of the blowdown and steady-flow turbines in which the fault of each is accommodated by the other. This system provides 30 per cent additional power at an additional weight penalty of only 19 per cent. A net gain is available, however, when the installations are compared on the basis of total power plant weight (engine plus fuel). The high power and low fuel consumption of the system, known as a "Compound Engine—Aircraft," is illustrated by its fuel consumption at 30,000 ft of only 0.32 lb per bhp-hr as compared to 0.85 for a reciprocating engine alone operating under the same conditions.

Turbine-Generator

An unusual but useful application of the gas turbine to aircraft is the development of a turbine-powered auxiliary power plant for aircraft by Westinghouse. The tiny turbine drives a 24-kw, 30-volt dc generator and a 2.5-kva, 120-volt, 400-cycle ac generator, thereby providing both ac and dc power. A new model will provide 400-cycle power at 40-50-kva for ac aircraft power and will include small dc generators for auxiliary 28-volt dc power.

Flying Boat

The end to a controversy is seen in a recent speech by Navy Capt. C. H. Schildhauer, in which he made clear that neither the Navy nor the nation had the slightest intention of abandoning the flying boat as either a military or commercial type. He answered critics (both naval and private) of the type's slow speed by revealing a confidence in future flying boat speeds in the 400-500 mph category, and of its efficiency by pointing out that a 400,000 lb flying boat could carry 12 per cent greater useful load than a landplane of the same gross weight.

Circular Wing

One of the most remarkable aircraft of recent times is the radical new Vought "Pancake" or "Skimmer" design. It consists of a circular wing with flattened edges. A propeller shaft extends longitudinally along each wing tip with a propeller in tractor position. The control surfaces are numerous and complex with the elevator comprising the flattened trailing edge and ailerons notched into each outboard aft section. The plane has made many successful test flights. It is being developed by NACA and the Navy Department in collaboration with Chance Vought Aircraft.

Operating Costs

Brief notes from American Airlines engineers reveal the operating costs of pressure cabins. In renegotiating their contract with Consolidated-Vultee to include pressure cabins on the 100 Model 240 twin-engine transports ordered, AA will pay $242,000 each instead of $180,000 each for the standard version. AA's engineering estimates indicate that direct operating cost will be increased from 4c to 5c per aircraft-mile, or approximately $5000 per aircraft-year.

Saturn Price

Lockheed has upped the price on its 14-passenger Saturn feeder-liner as a result of re-appraisal of the market. Its contract with Southwest Airways was signed at $85,000 maximum and this figure was used in negotiations with All-American Aviation and other feeder lines. This price was based on a 300-unit production schedule, but the new analysis has lowered the sights to a 100-plane work order. Lockheed engineers are now quoting $115,000 to $120,000 each on the Saturn due to the smaller production quantity and rising labor and materials costs. Boeing is holding fast to $145,000 for its Model 417 and Beech has announced $125,000 for its new 20-passenger model. All three are nearing completion and are scheduled for production next Fall.

Gust Loading

The AAF and NACA are cooperating in a series of gust investigations with 10 Northrop P-61 Black Widow fighters specially instrumented for the job. The planes are flown through thunderheads directly into the turbulent interior while instruments record temperature, density, pressure, precipitation, gust direction and intensity, etc. Object of the tests is to determine maximum gust loadings required for new designs. Gust loading has become the critical structural design parameter in large, high-speed bombers and transport types. The Boeing B-29 Superfortress, for example, is designed for a gust loading of 234 psf, considerably higher than its conventional maneuvering design loads.

Turret Cannon

British Avro Lincoln heavy bomber is the first production type in the world to be announced with power-driven turrets mounting two 20-mm cannon. The turret is located in the upper rear fuselage and can be radar aimed.

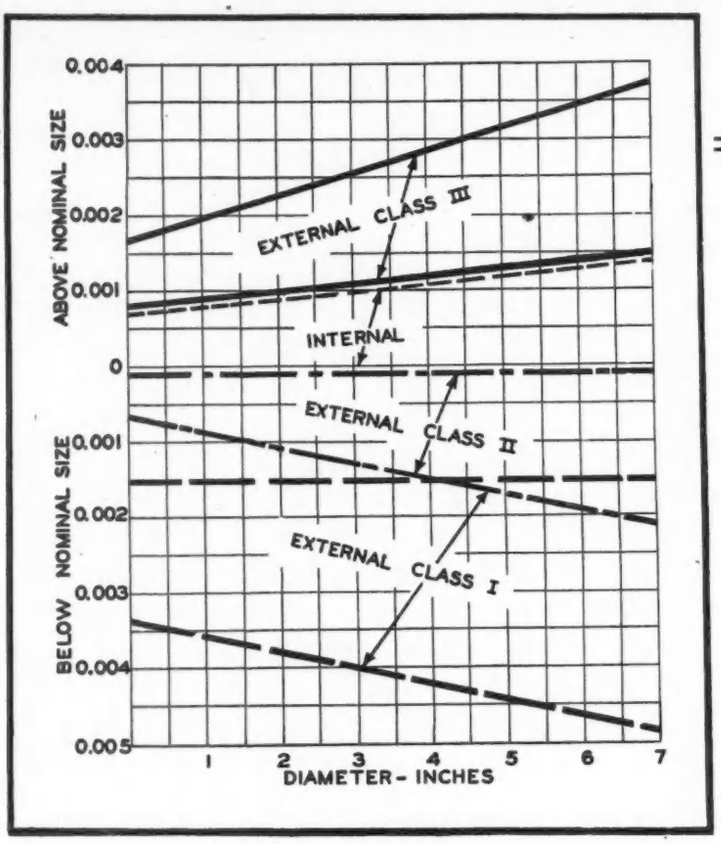


Chart 1. Major Diameter Fits.

Fits and

THERE are three ways of fitting splined parts: on the major diameter, on the sides of the teeth, and on the minor diameter. Major diameter fits are most generally used as the major diameter is usually accurately held, probably by grinding, and often is used as a pilot or locating point for other dimensions. The broach which cuts the internal teeth is accurately made on the major diameter, and therefore there are good reasons for using the major diameter to control fit.

Since the involute form must be accurately cut on both internal and external, it is therefore a good fitting point. Errors of spacing sometimes make such a fit difficult, and these errors, combined with errors of cutting the involute form, introduce an eccentricity not present in the major diameter fit. For the full fillet form of tooth, however, this fit is the only one which can be used as there is a large clearance at both major and minor diameters.

The minor diameter fit is used where the manufacturer favors grinding the minor diameter of the internal spline to vary the fit on a shaft which is held standard. It is particularly adapted to the straight spline, where the minor diameter of the external (shaft) can be form ground to contact the ground minor diameter of the internal spline.

Either major or minor diameter fits are comparable with plain cylindrical fits and may follow well established practice, but side bearing fits have other complications. If tooth spacing and form were perfect, these fits could be treated as a cylindrical fit, but errors of cutting will sometimes change a free fit to a tight fit, so it is good practice to allow more clearance for this type.

Major and Minor Diameter

When the subcommittees* took up the question of fits, on the major and minor diameters, there were two groups vitally interested, one for the involute, and the other for the straight spline standardization. In January, 1945, they met together and agreed on three classes of fits for 1.25 diameter.

Sliding	0.0015 loose to 0.0045 loose
Close	0.0001 loose to 0.0018 loose
Press	0.0001 tight to 0.0021 tight

Further, all fits are to be varied with diameter on the basis of 0.0003 per inch of diameter, with the extra allowance on the free side for clearance, and on the tight side for interference or press fits. On this basis charts were made, and are presented here as a record.

Chart 1 shows the major diameter fits, based on size of internal which varies 0.0001 per inch of diameter on the tolerance. Each of the external splines has a tolerance with a variation of 0.0002 per inch of diameter, to make a total of 0.0003.

Chart 2 shows the minor diameter fits, just the same as that for the major diameter chart, except that the external, as the standard or unchangeable member, has a 0.0002 variation per inch of diameter, and the internal in each case has a variation of 0.0001, making a total of 0.0003 per inch of diameter.

Limiting assembly to one position may be accomplished by making the external spline in the usual way and afterward milling out one tooth. The broach is then made with one tooth omitted, which leaves a wide tooth in the product to fit the wide space in the external spline. An alternate method is to fill up a space in the internal spline, which can be done by pressing a pin through the rim into the space.

Measuring Splined Fittings

The most accurate means of checking a splined part

* A committee serving the interests of SAE, ASME, AGMA, and NMTBA has prepared a new standard for involute splines and has had approval of all of the sponsor societies. For details, see the paper, "Engineering of Involute Splines," by the author of this article and presented by him at the 1946 SAE Annual Meeting in Detroit. This article is an excerpt from that paper.

By George L. McCain
Staff Engineer-Research,
Chrysler Corp.

Tolerances of Involute Splines

for size is that used for involute gears; that is, with pins. The two pins used contact the involute tooth form, and the micrometer measurement, between the pins for internal splines and over pins for the external splines, is a check of the space or tooth width. This method is too slow, however, for mass production, and does not check errors in tooth spacing or involute form; therefore, plug and ring gages are used which do detect spacing errors, and are much faster to use. These gages must be checked with pins and space checkers, so that the pin method is basically the most direct way of defining measurements of space and tooth thickness for mating parts. For the benefit of the gage maker, it is advisable, in the specifications, to indicate how much variation may be allowed in both spacing and involute form.

Professor Earle Buckingham has developed formulas for gear measurements, which can be adapted to the measurements of spline fittings.

Variation of Spacing, Tooth Form, etc.

If two mating splined parts are cut with a circular tooth clearance of 0.001, and one or more teeth are out of correct spacing in the same direction 0.0005, there will still be 0.0005 clearance. If some teeth are out 0.0005 in one direction, and some others are out 0.0005 in the opposite direction, there will be no clearance left. If the total variation from plus to minus is greater than the desired clearance, there will be an interference which will still further be aggravated by any tooth form outside the true involute. The plug gage takes these elements into account, so that any part which accepts a "go" gage will assemble with its mating part as designed.

The Vinco Co. has contributed materially to the art of spline production. Practical experience with splined fittings frequently shows a discrepancy between actual tooth thickness and space width dimensions (as measured with pins or tooth calipers) and the backlash when the parts are assembled. It appears that the fit of two mating parts is usually tighter than anticipated from the difference between the space width of the splined hole and the tooth thickness of the splined shaft. The reverse condition occurs when parts are checked by means of spline gages having a full complement of teeth. In this case, the part splines appear to be looser in the assembly. These inconsistencies frequently cause serious difficulties in the production and inspection of splined parts. They are caused by spacing errors and other unavoidable deviations. The following concept constitutes an attempt to clarify these conditions by proposing a new terminology intended to simplify the consideration of these complex conditions. There is every reason to expect that the adoption of this new terminology will help to eliminate practically all difficulties in the interpretation of inspection results.

There are basically four errors which prevent

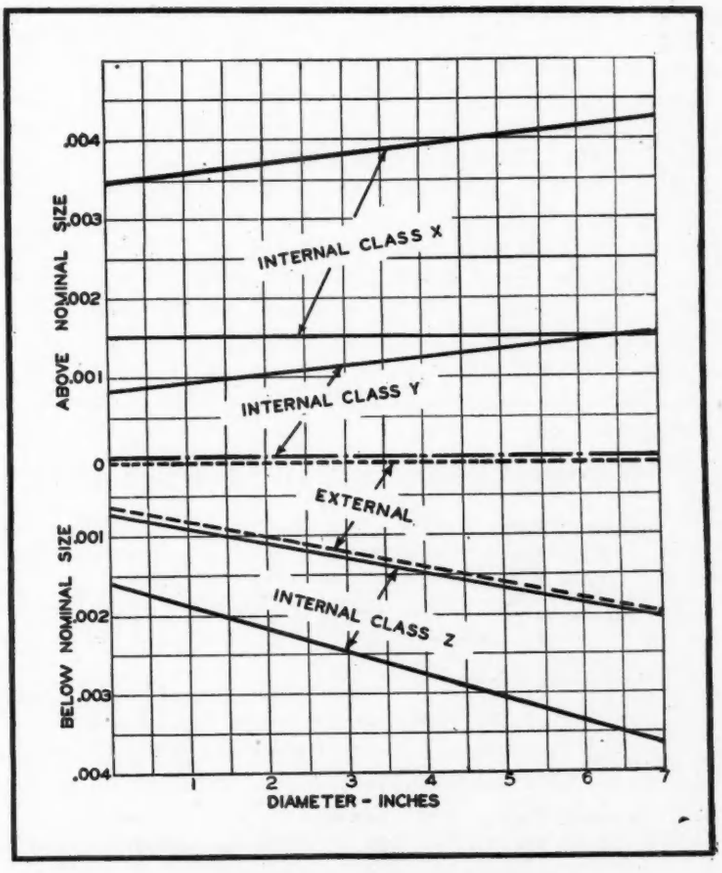


Chart 2. Minor Diameter Fits.

splined shafts of a given tooth thickness fitting splined holes of equal space width, as measured with pins, tooth calipers, or similar means. These errors are:

(a) Spacing errors.
(b) Positive profile errors, i.e., profile deviations in the direction of the space.
(c) Alignment errors.
(d) Roundness errors.

Inasmuch as these errors cause interference with the ideal perfect spline contour having the given tooth thickness, their combined effect is designated as "interference error."

Effective Tooth Thickness and Space Width

If a splined shaft has a measured tooth thickness, "t," and its interference error amounts to "e," its effective contour will partly interfere with the ideal contour of the tooth of thickness "t." Points on the actual contour will be outside the perfect contour by as much as "e" inches. The fit of this splined shaft, or its backlash with a mating member, will be the same as if it had a tooth thickness equal to "t" plus "e." This corrected tooth thickness is termed "effective tooth thickness," since it expresses the effect of all irregularities on the fit obtained in the assembly. The tooth thickness "t" as measured is designated as the "actual tooth thickness" of the splined shaft. The effective tooth thickness equals the actual tooth thickness plus the interference error. The same reasoning applied to splined holes leads to the terms "effective space width" and "actual space width."

The effective space width equals the actual space width minus the interference error. When two splined parts are assembled, the fit between both members depends only on the "effective space width" of the splined hole and the "effective tooth thickness" of the splined shaft. If these two dimensions are equal, a metal to metal fit, although only at spots, should be expected even if the actual space width of the splined hole is larger than the actual tooth thickness of the splined shaft. An excess of "effective space width" over the "effective tooth thickness" of the mating member results in backlash, while the reverse condition produces press fit.

Backlash equals effective space width of splined hole minus effective tooth thickness of splined shaft. The difference between the effective and actual dimensions on each member is a measure of the uniformity of the spline and has a definite relation to the wear life of the splined fitting. An excessive interference error causes loss of spline contact and excessive stress in the few contacting spline teeth.

Part Specifications

The terminology presented above requires new methods of specifying part splines. It must be recognized that each manufactured splined shaft has an actual tooth thickness and an effective tooth thickness and that each manufactured splined hole has an effective space width and an actual space width. If all spline elements were measured on each part coming from a production line, it would be possible to establish

Maximum effective tooth thickness.
Minimum effective tooth thickness.
Maximum actual tooth thickness.
Minimum actual tooth thickness.
Maximum effective space width.
Minimum effective space width.
Maximum actual space width.
Minimum actual space width.

In determining the specifications for each member of the splined fitting, it will be necessary to decide which of the dimensions listed above should be controlled. In considering a splined shaft, it will always be necessary to establish a definite limit for the maximum effective tooth thickness which controls the tightest fit. The maximum actual tooth thickness need not be less and cannot be more than the maximum effective tooth thickness. Yet, its specification may be desirable if the maximum interference error produced by the available machine tool equipment is known. The specified maximum actual tooth thickness provides a basis to check the shaft spline while it is still in the machine and thus make sure that the finished part will have an effective tooth thickness which does not exceed the specified maximum. On the other hand, if difficulties arise in the final inspection of the part spline, the specification of a maximum actual tooth thickness will make it possible to determine whether the interference error, or the tooth thickness is excessive.

The minimum actual tooth thickness should always be specified in or-

Range Clearance for Each Class

Diametral Pitch	Class A	Class B	Class C
1/2 to 4/8	+.0020 to +.0060	+.0030 to −.0010	0 to −.0035
5/10 to 8/16	+.0015 to +.0045	+.0025 to −.0005	0 to −.0030
10/20 to 20/40	+.0010 to +.0035	+.0020 to −.0005	0 to −.0025
24/48 to 48/96	+.0010 to +.0030	+.0020 to 0	0 to −.0020

Clearance (+)
Interference (−)

The tolerances in each of the three classes for space width and tooth circular thickness are:

Diametral Pitch	Internal	External — Class A	External — Class B & C
1/2 to 4/8	+.0020 −.0000	+.0000 −.0020	+.0000 −.0015
5/10 to 8/16	+.0015 −.0000	+.0000 −.0015	+.0000 −.0015
10/20 to 20/40	+.0010 −.0000	+.0000 −.0015	+.0000 −.0015
24/48 to 48/96	+.0010 −.0000	+.0000 −.0010	+.0000 −.0010

der to make sure that the backlash will not exceed its absolute maximum even after the high spots of the spline profile are partly or completely removed by wear or deflection.

The minimum effective tooth thickness cannot be less and need not be more than the minimum actual tooth thickness. It might, therefore, be only of minor importance, unless no great wear or deflection is expected.

(a) If the minimum effective tooth thickness is not specified and the maximum actual tooth thickness is also eliminated, there will be only two limits on the part print, the maximum effective and the minimum actual tooth thickness. In this case, all errors are to be absorbed within the given limits. It will be necessary, however, in establishing these limits to make sure that such absorption is possible.

(b) If a maximum effective tooth thickness is specified in conjunction with the maximum actual tooth thickness, the difference between these two specifications may be determined on the basis of the maximum anticipated interference error.

(c) It is also possible to establish effective tooth thickness limits which allow for only partial accumulation of interference errors. In this case, the difference between the specified effective and actual dimensions represents only a percentage of the total interference error.

In expanding the concept of this paragraph to apply to splined shafts, and also to splined holes, the following general conclusions may be established in the form of three alternatives for the spline designer.

(A) All interference errors are to be absorbed within the given tooth thickness, or space width limits.

(B) All interference errors are permissible in addition to the tolerance on the actual tooth thickness or space width.

(C) Only a portion of the interference errors is permissible in addition to the tolerance on actual tooth thickness or space width.

If the amount to which interference errors are allowed to be accumulated is designated as, "interference allowance," it will be zero in (A), equal to the total interference error in (B), and equivalent to part of the interference error in (C).

The proper selection of interference allowance depends on the evaluation of the interference error as produced by the available tool equipment, on the design requirements, and the inspection procedure. The requirements consist of so many factors that a general requirement cannot be formulated.

Side Bearing Fits

Because of the extensive use of broaches for cutting the internal spline, and due to the cost of such equipment and its fixed nature, the internal spline is held to the basic dimension with a plus tolerance, just as in screw thread practice the tapped hole is held. The external spline is then made with a high limit on tooth thickness to the desired maximum press or minimum clearance and a minus tolerance applied.

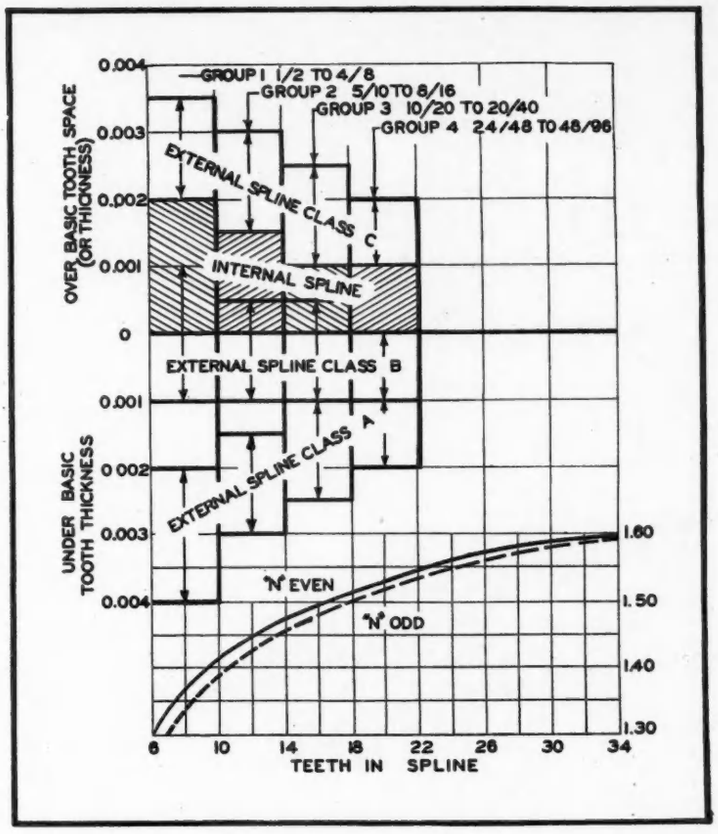


Chart 3. Tooth Side Fits.

Three classes of fits are provided, within each of which some selection can be exercised. Three divisions in the range of pitches are used, because coarse pitches cannot and need not be held to such close limits as the fine pitches. Tables on the facing page show ranges of clearance or interference for each class (see Chart 3).

The tolerances in the tables refer to TOOTH THICKNESS, and these must be converted to measurements over or between pins.

When special loose fits are required, it is necessary to make several adjustments in dimensions. The extra looseness at the tooth will allow some movement out of axis of the external in relation to the internal, but not by the full amount of the extra clearance, due to spacing errors. An extra amount of tooth side clearance would allow one half of it in each direction from center, or a total adjustment of the amount of clearance. This assumes no error in spacing or form. If an interference allowance of 0.0005, or a total of 0.001 is made for each member, subtract the latter from the total maximum clearance, and this becomes the amount for adjustment of either TIF* of major or minor diameter. Since the internal is standard, the best course to follow is to decrease the major diameter of the external and increase the minor diameter of the internal by this amount. The second choice is to increase the TIF of the internal, and decrease the TIF of the external, by this amount, and, of course, this would have to be done for a major diameter fit.

* TIF is the symbol for the diameter at the junction of the involute form with the fillet.

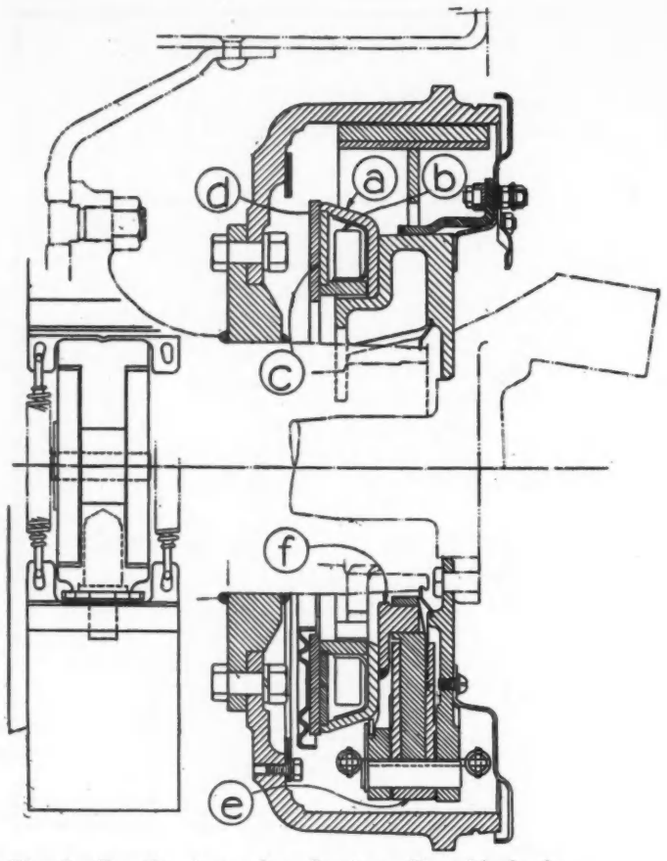


Fig. 1—Details of two-shoe floating adjustable brake mechanism, showing the principal components.

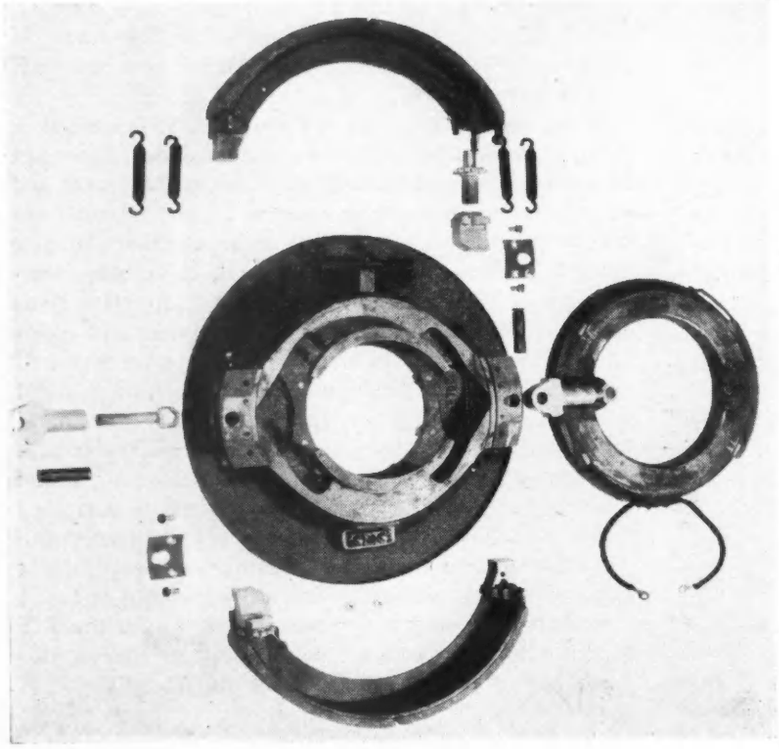
The electro-magnet (a) contains the coil (b) and friction lining segments (c), while the Armco iron segments on the armature are indicated by (d). The brake shoe actuating cam is shown at (e). The element (f) is the lug which actuates the cam, being fixed to the magnet frame as shown.

PIONEER in the field of electric brakes for motor vehicles, the Warner Electric Brake Mfg. Co., Beloit, Wis., introduced its product as a means of endowing trailers with quick-stopping ability. Before long the application of the system was extended to heavy transport trailers in sizes up to 17¼ x 5 in.; and in sizes up to 21 x 3 for large gun carriages. During the war the organization was called upon to provide brakes for some of the heaviest pieces of military equipment used by the Army, most striking of these being the "compound" brake which became standard equipment on the 120 mm AA gun mount.

Stemming from the pressure of increased war requirements, Warner found it necessary to make progressive additions to its plant and equipment with the result that the company now is in a position to produce brakes on a major scale. Coincidentally, they have adopted advanced production methods and have increased research facilities so essential to the development and improvement of the product.

Design Features of the

Warner



By virtue of know-how and the growing evolution of product design, there are available a variety of brakes in basic types and sizes suitable for the requirements of the allied automotive fields. Among these are: trucks, trailers, highway trailer trains, buses, aircraft, highway maintenance machinery and vehicles, off-the-road vehicles and machinery, industrial motors, and industrial machinery such as machine tools.

Currently the line includes the familiar full-wrap brakes augmented by the following new types which will be made available in accordance with demand: (1) Two-shoe hinged type having self-

Fig. 2—Exploded view of two-shoe floating brake, showing the magnet assembly, brake shoes, cams, backing plate, and small parts.

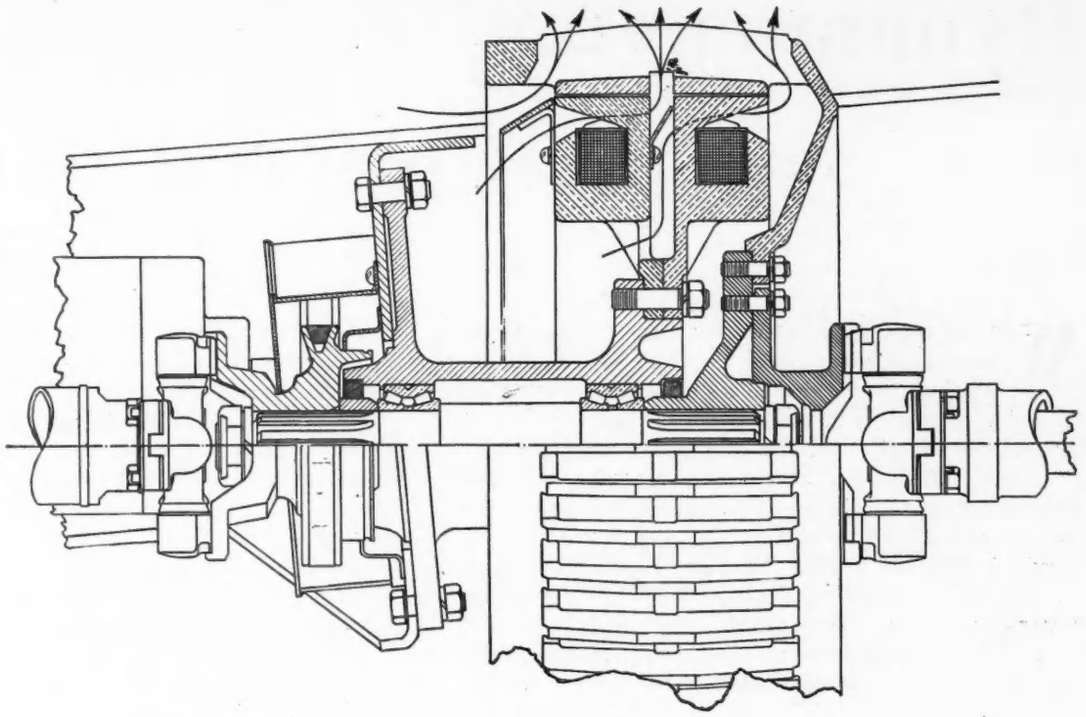


Fig. 4—Cross-sectional arrangement of the Warner eddy-current supplementary brake for special installations.

energizing characteristics, (2) two-shoe floating type with mechanical adjustments for wear, (3) two-shoe floating non-adjustable type, and (4) the compound type for extra heavy duty service. In addition, there is the Eddy-Current system for supplementary braking on heavy duty vehicles or trains traversing hilly or mountainous routes. This system, to be described later, provides the means for controlling the vehicle on grades, relieving the wheel brakes of abnormal loading and destructive wear.

Before getting to a description of the basic lines mentioned above, it is of interest to comment briefly upon the operating principle which is common to Warner brakes. The electric brake may be considered a dynamic brake deriving its power application from the movement of the vehicle. Brake actuation and control are afforded by means of a friction clutch, actuated by magnetic force.

Mechanical simplicity is an outstanding attribute of this brake. It consists,

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Electric Brake

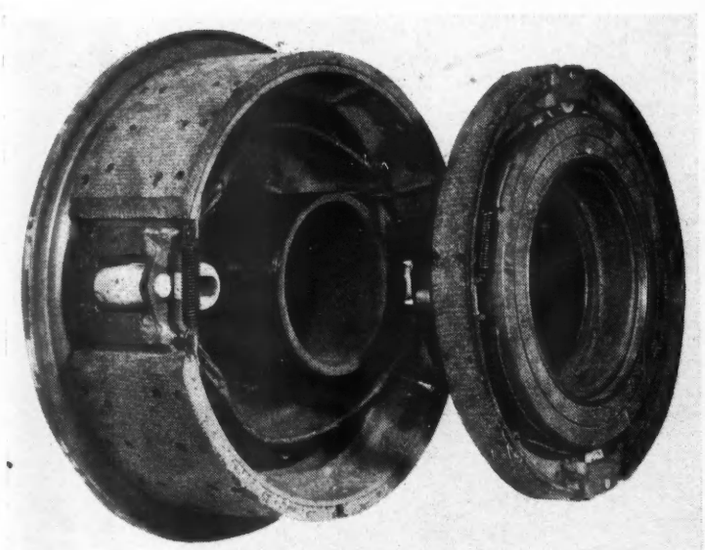
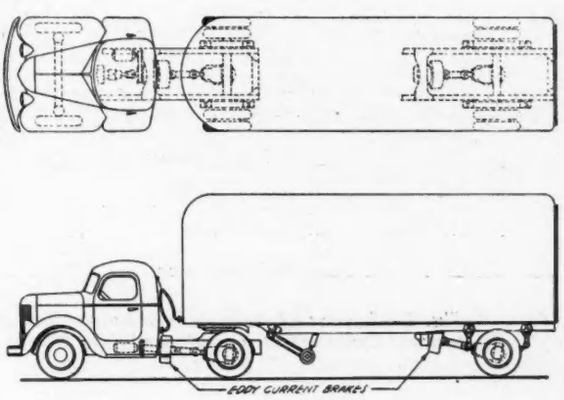


Fig. 3—Photograph of the Warner "compound" brake for exceptionally high GWV vehicles. As described, it consists of a small auxiliary two-shoe brake which incorporates the magnet system, and the heavy two-shoe main brake.

Fig. 5—Schematic chassis application of the eddy-current brake on a heavy tractor-trailer unit.



Dynamometer Testing *of High Speed* Powered Aircraft

WIND tunnel tests of aircraft models under simulated power-on conditions have required the extensive use of electrically driven power units. In order to reach full scale propeller tip speeds and also adjust the physical size of the electric motors so that they will fit into the contours, nacelles, or other body assemblies of the airplane models, it is necessary to attain high shaft speeds and yet minimize the physical size, delivering the required scale model horsepower. To perform this task a high frequency alternating current is required. When it is necessary to run these model motors their usefulness is not realized until the actual shaft horsepower and the thrust of the propellers connected is known. It is for the purpose of determining the shaft horsepower that dynamometers are required.

The usual procedure is to run curves of torque versus electric input on the dynamometers at various shaft speeds. Then by duplicating test voltage and frequency in the wind tunnel we can refer the readings of electric input and shaft speed to the calibration curves previously taken from the dynamometer test. The exact shaft output in the tunnel test is in this way determined with high accuracy. This accuracy, of course, depends on the absolute accuracy of the dynamometer torque measurements, the measurement of shaft speed, and the repeating accuracy of the electrical instruments in use.

Up to now the maximum limit of

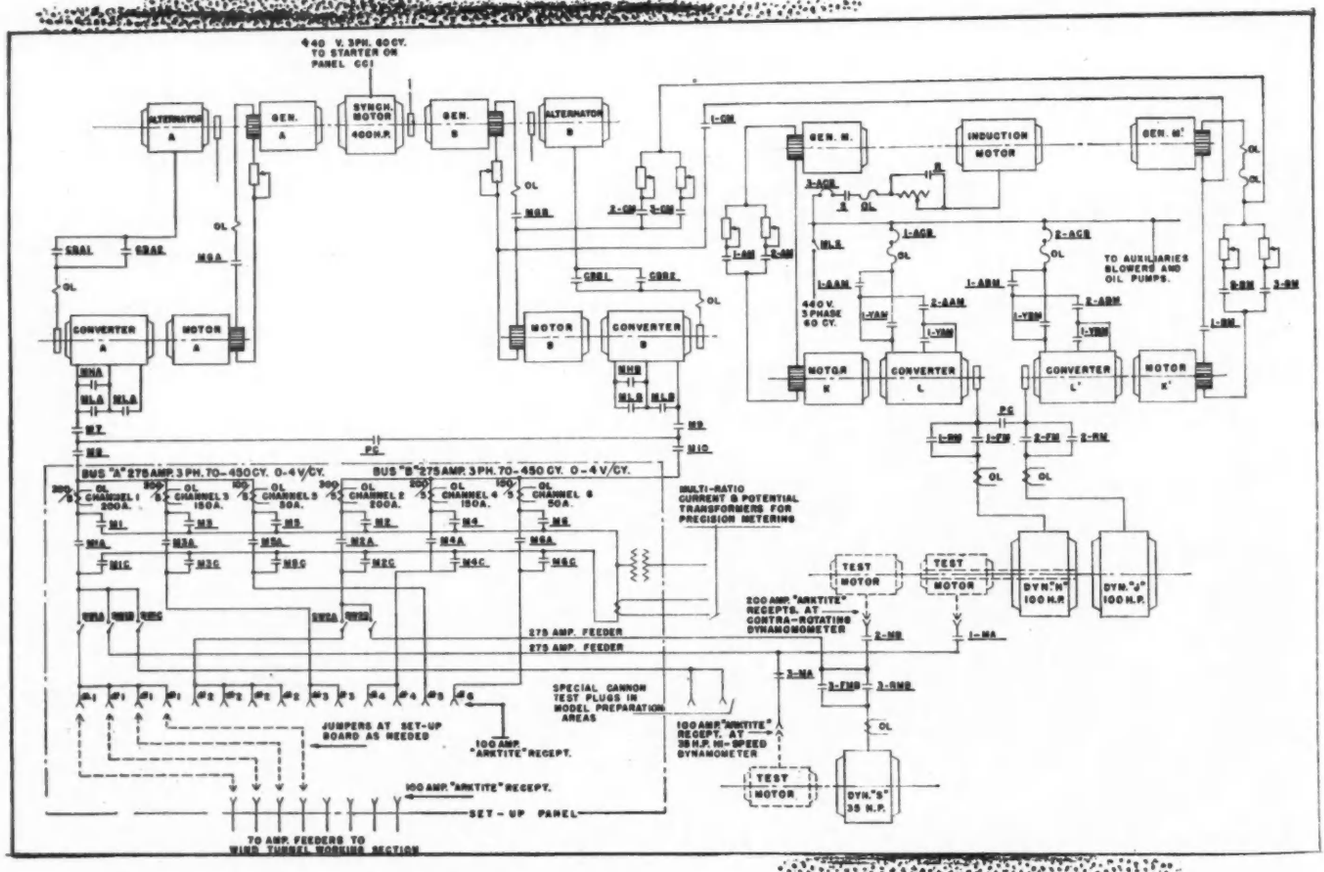


Fig. 1—Layout of electrical equipment for wind tunnel dynamometer and variable frequency power.

Motors for

Models

By H. Orville Cox,

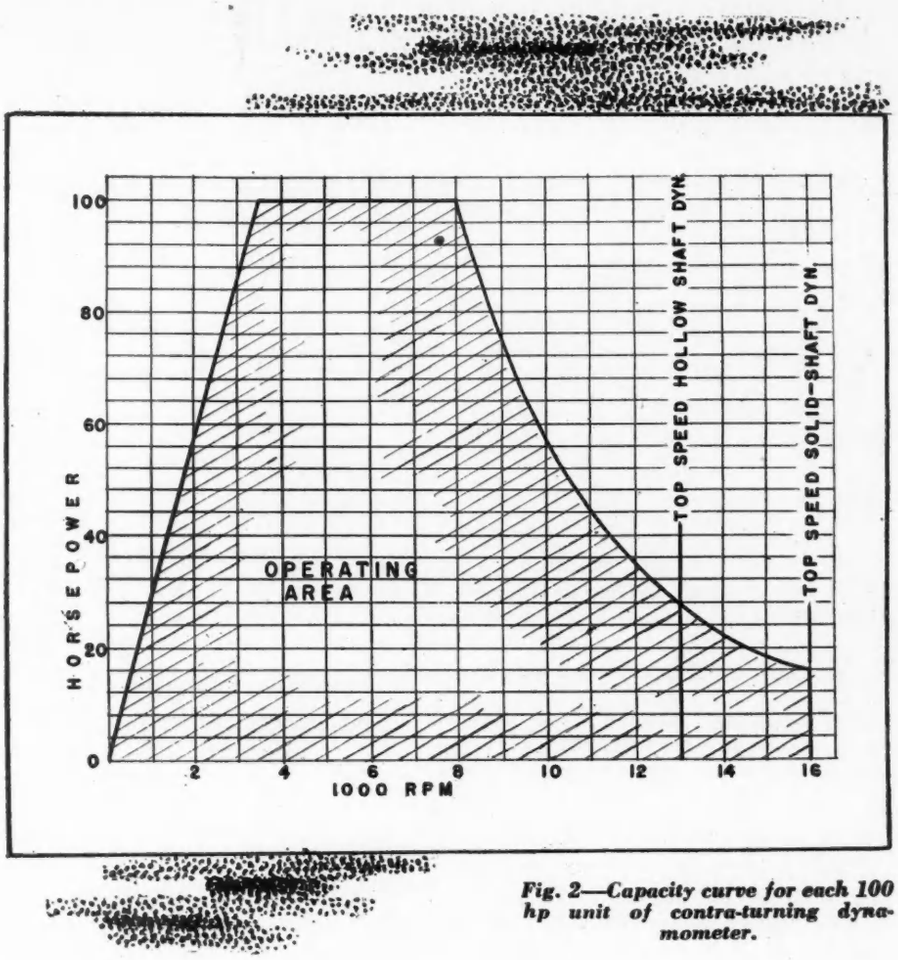


Fig. 2—Capacity curve for each 100 hp unit of contra-turning dynamometer.

model motor shaft speeds has in general been so high that it could not be properly handled by existing dynamometer equipment. This was partly due to the fact that short bearing life can be expected in the model motors themselves. Life of bearings amounting to a few hours was sufficient and one set of bearings was considered to have served its purpose if it lasted through a complete wind tunnel test. The bearing performance in dynamometers, however, in order to have a suitable service life must perform continuously through an on and off cycle, the only limitation being that the bearing temperature must be kept below the recommended maximum.

In the high speed dynamometers described here, dependable performance from bearings is obtained with the use of an "oil mist" lubrication system. Another factor contributing to favorable performance was the preciseness with which the bearing inner and outer race machining fits were determined. After the proper fits were determined the use of matched super-precision bearings insured the required performance.

By holding the out-of-balance forces to a minimum at critical speeds through very careful designing, by using the "oil mist" lubrication system, together with the use of selected super-precision bearings, a high speed performance up to 10 hp at 27,500 rpm was obtained in one unit and 25 hp at 13,000 to 16,000 rpm was obtained in two larger units. Dynamometers which can give this type of performance and still be manufactured on a commercial scale may well be considered an outstanding accomplishment in electrical machinery. A technical description of such equipment and its accessories follows.

The Dynamometers

The power absorbing capacity and speed range of dynamometer units were chosen so that any model motor to be tested would fall within the capacity of some one of the units or of the two 100 hp units when used in tandem. In addition, the possibility of testing contra-rotating motor assemblies was also taken into consideration by building one of the 100 hp machines as a hollow shaft unit. Utilizing special couplings, the two 100 hp units can then be used together in running a test on the dual rotation motor assembly.

The dynamometers we have installed are an induction type cradled unit with oscillated trunnion bearings. The induction units are fed through variable frequency converters, thus allowing the machines to absorb or provide motoring power and permitting the recovery of all power except losses in the machines themselves. Motoring allows the operator to neutralize friction and windage of the dynamometers and reduce the load on model motors under test to zero if necessary. When used as motors, the units become a source of accurately measured shaft power to operate and test such devices as airplane generators, blowers, axial flow fans, turbines or other devices requiring power and speeds within the range of dynamometer capacity.

A contra-rotating unit was installed which consisted of two 100 hp dynamometers lettered "H" and "J" in Fig. 1. Dynamometer "H," which is a hollow shaft unit, has a basic rating of 100 hp absorption at 3500 rpm and an allowable top speed of 13,000 rpm. Dyna-

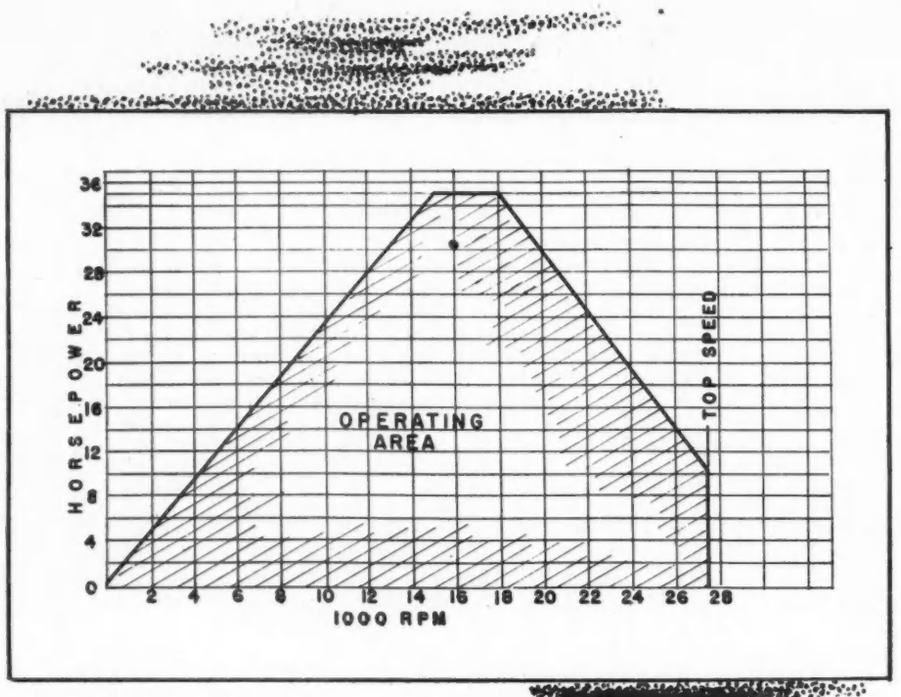


Fig. 3—Capacity curve for high speed 35 hp dynamometer.

mometer "J" has a solid shaft and has a basic rating of 100 hp absorption at 3500 rpm with a top allowable speed of 16,000 rpm. Referring to Fig. 2, the maximum allowable capacity at any speed is designated by the line indicating the boundary of the operating area. Each dynamometer will deliver 75 hp when used as a motor.

In Fig. 1 the dynamometer lettered "S" was installed to cover very high speed lower horsepower motor testing. This dynamometer has a basic rating of 35 hp at 15,000 rpm with an allowable top speed of 27,500 rpm. The 35 hp rating applies over the speed range of 15,000 to 20,000 rpm with the capacity dropping to approximately 10 hp at 27,500 rpm. The maximum capacity corresponds to the outer boundary of the operating area shown on Fig. 3. This dynamometer when used as a motor will deliver 25 hp.

The dynamometers have been given a temperature rating on a time limit basis—30 min without injurious heating. Actually the machines have Class B insulation which allows a maximum continuous temperature of 125 C in the windings and, if runs longer than 30 min are required, it is necessary merely to watch winding and bearing temperatures. The latter can be influenced by the rotor temperature and this in turn must consequently be limited. Maximum safe operating temperatures of bearings has been placed at 85 C. In cases where long runs or runs at very high speeds are required, a close check can be maintained on these temperatures by means of thermocouples imbedded in the stator and at the bearing outer races.

The 100 hp dynamometers are provided with torque arms on both sides of each machine (see Fig. 4). A pan for counterpoise weights was placed on each arm at a 36 in. lever arm distance allowing the units to be operated with either rotation. Most of the dynamometer torque is balanced out by use of counterpoise weights and the remainder is recorded on a Toledo scale. The scale is attached at one torque arm at a lever arm of 36 in. and has a full scale range of two lb graduated in 0.01 lb divisions.

The 35 hp dynamometer scale arrangement (Fig. 5) is similar to the larger units except that the Toledo scale is attached to a torque arm at a distance of 24 in. from the shaft centerline and has a full scale range of 0.5 lb graduated in 0.005 lb divisions. The lever arm distances for the pans are also 24 in.

Suitable counterpoise weights are available to provide a maximum of 50 lb on each torque arm on the larger units and a maximum of 6.5 lb on each arm of the 35 hp unit. These weights are made of brass, calibrated according to U. S. Standards for counterpoise weights with a maximum tolerance limit of plus or minus 0.00125 lb for the larger weights. The combined error due to friction in the trunnion bearings, scale and weight errors, was found to be approximately plus or minus 0.01125 lb or 0.03375 lb-ft on the 100 hp dynamometers. A similar combined error on the 35 hp dynamometer is approximately plus or minus 0.005 lb or 0.01 lb-ft.

Origin of the Variable Frequency System

When engineering work was begun on the Curtiss-Wright (now Cornell) Variable Density Wind Tunnel at Buffalo and on the Cooperative Wind Tunnel of Southern California at Pasadena, a very complete survey was made on power requirements for use with powered models in wind tunnel tests. From information gained in this survey and past experience, a system was designed to provide suitable capacity, fairly high frequency, and optimum utility. The last qualification was important since the final system chosen was to be one with two equal power sources capable of operating separately at different frequencies or of operating in parallel at the same frequency in order to take advantage of full power installed. This type of system evolved after the arrival of contra-rotating propeller drives in aircraft design. In such a drive dual-rotation is required in the two driving motors and under certain conditions different rotating speeds may be required for the two propellers. This purpose was served by the two equal systems, yet by paralleling the two and operating them as one, the entire out-

put of the converters being available to drive a nacelle model or single motored model requiring power in the 400 hp class.

In the latter part of 1941 when the survey was made some of the aircraft companies already realized and indicated that they would like 800 cycles available for driving models with axial flow fan systems or turbine drives. The high cost of obtaining this high frequency from rotating equipment, furnishing variable frequency from 70 cycles up, limited this desire and 450 cycles was accepted as a maximum frequency economically possible from the equipment.

The following data obtained from the survey indicate power requirements in wind tunnel models. One must recognize, however, the fact that since 1941 power loading of aircraft has continuously been on the upward trend, and whereas these figures listed are based on internal combustion engines in the 3000 to 4000 hp class, the requirement of model power today will probably be larger since we have improved power plants for future aircraft. Nevertheless, the variable frequency system installed can handle the present demand since its capacity has been made larger than that required by the original survey.

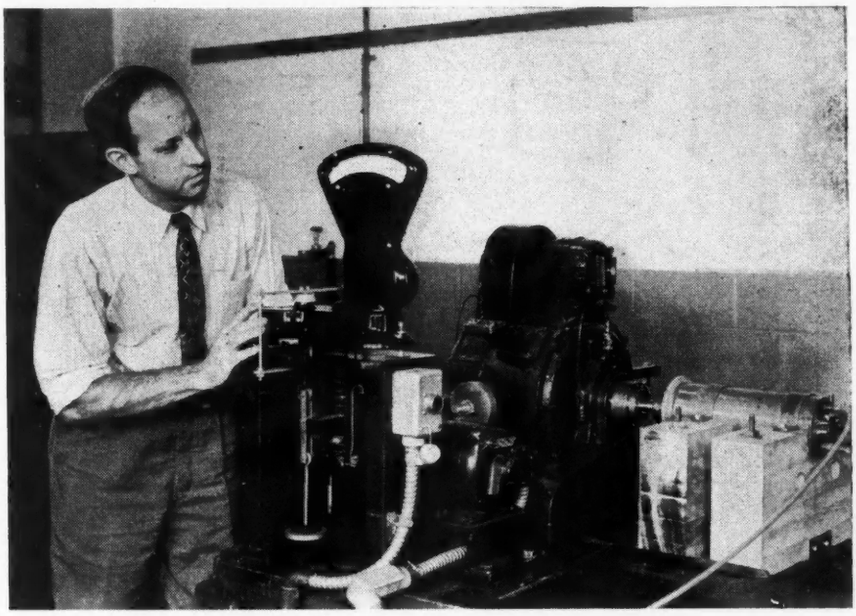


Fig. 5—35 hp high speed dynamometer with model motor coupled and under test.

Variable Frequency Power Distribution and Precision Metering

Referring to Fig 1, Bus A and Bus B are both capable of handling 275 amp of variable frequency power. Converters A and B feeding the buses have individual ratings of 134 amp at 0.85 power factor, 3 phase, 150 cycles, and 540 for a duty cycle of 30 min on and 30 min off. This rating may be described as a basic rating when connected in series delta. At high frequencies the load must be decreased on the converters on a heating basis. So that the heating capacity of the machines may definitely be utilized, the converters as well as the d-c driving motors are arranged with forced ventilation. By means of double windings on the stators of the converters the power available on the variable frequency buses may be as much as 268 amp at 0.25 to 2.0 V per cycle when connected in parallel delta, or 134 amp at 0.25 to 4.0 per cycle when connected in series delta.

In order to take electric instrument readings accurately, the variable frequency current is first fed through the "setup" panel. Precision metering current and potential transformers are located in this panel. After the current is metered it is carried to any of the distribution points selected. In this particular laboratory power may be fed through as many as eight 70 amp circuits to the wind tunnel working section where a model is under test, or to one of two model preparation areas, or through two 275 amp circuits to the dynamometer testing room.

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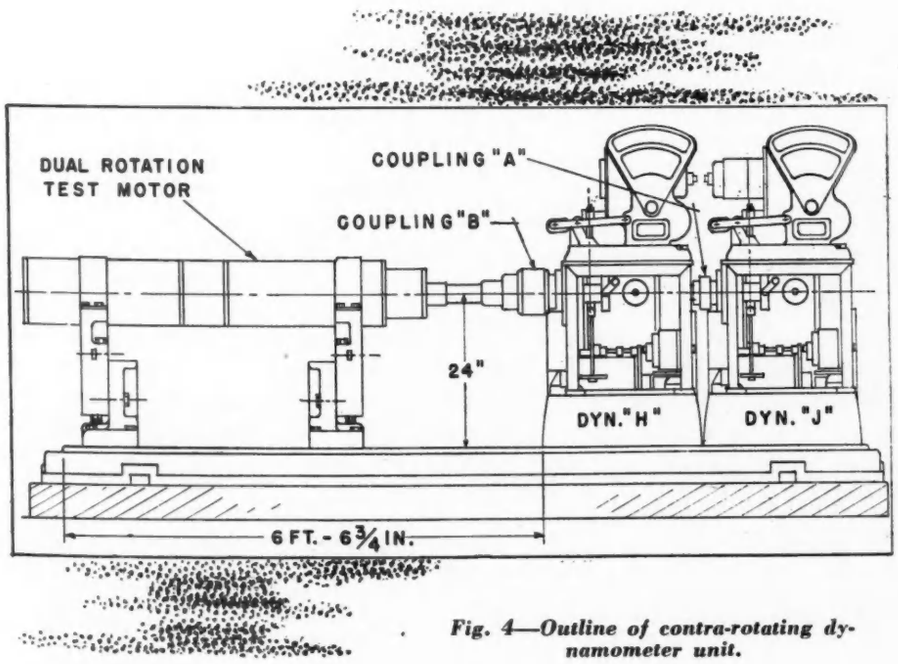


Fig. 4—Outline of contra-rotating dynamometer unit.

Evaluation of

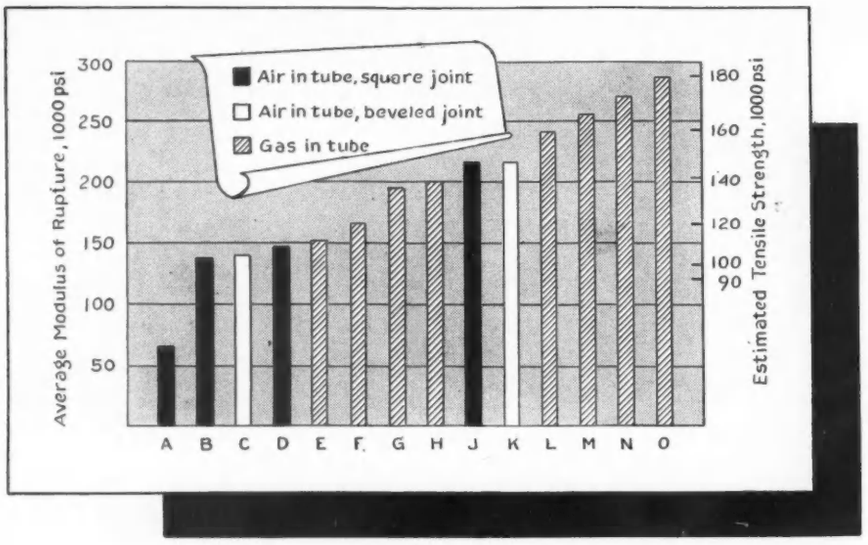


Fig. 1—Average strength of closed joint pressure welds made with various schedules

A4135 Steel Tubing 3 1/16 in. and 3 3/16 in. B.D. x 13/32 W.T.

Upset distance 0.250 in. in all schedules except B, C, F, J, and K. All tubes heat-treated to approximately 190,000 p.s.i. U. T. S. (Modulus of yielding for unwelded tube is 330,000 psi)

THE greater part of this experimental work with alloy steels was done using the closed-joint pressure-welding method, in which the faces to be joined are butted firmly together, heated from the outside, and upset when the weld zone has become plastic. Most of the tests were made on A4135 chromium-molbydenum seamless steel tubing of 3 1/16 in. OD by 13/32 in. wall thickness. More recent tests were made on 3 3/16 in. OD by 13/32 in. A4135 seamless steel tubing from the same heat.

Perhaps the principal conclusion that can be drawn from this work is that it is considerably more difficult to attain 100 per cent weld-joint efficiency in an alloy steel part, from which all the weld reinforcement has been removed and which is heat treated after welding, than in a plain carbon steel or alloy steel part which is left with the weld upset intact. In the tests where the weld reinforcement was not removed from the specimens, nor were they heat treated after welding, it was not very long before welding sequences had been established which produced welds that were as strong in bending as the adjacent tube material. However, when similar welded tubes were machined smooth on the outside and inside to remove the upset, and the tubes were heat treated to a high tensile strength, most of the specimens failed on the weld line when tested in bending. Some of the weld failures took place at very high loads, but in general the load required to produce failure on the weld line was less than that required to cause buckling of an unwelded tube.

It is possible to make pressure welds which, if the strength and service requirements are not too severe, and some weld reinforcement is retained, will consistently be as strong as the stock. As the strength requirements are increased, and as the weld reinforcement is reduced or eliminated, it becomes increasingly more difficult to secure 100 per cent joint efficiency. This situation is encountered in other forms of welding, such as flash-welding and arc welding. If the results reported here suggest difficulties in obtaining 100 per cent efficiencies under relatively severe conditions, it may be recalled that pressure welding is no different than other types of welding in this respect.

Numerous welding schedules were tried in an attempt to improve the quality of the welded joint so that it would have a unit strength equal to that of the parent tubes. Various combinations of pressure, rate of heating, duration of heating, oscillation of the ring burner, and amount of upset were tried. With some schedules strong welds were obtained, but it was still impossible consistently to produce 100 per cent efficient joints. Explanations for this, such as poor gas pressure, regulation, faulty burner design, erratic behavior of the hydraulic pressure system, and inadequate preparation or protection of the welding faces, were investigated but they appear unwarranted. Welding schedules were used which almost certainly entailed adequate upsets, a high enough internal temperature, a long enough heating time, and careful preparation of the welding faces. Some difficulties were encountered in the regulation of the gas flow to the ring burners, and with the characteristics of the burners, but even these were believed to be under satisfactory control.

The results point to one principal cause of inconsistent weld strength, namely, the presence of oxygen as oxides or in solution at the plane of the weld. The necessity of maintaining clean, unoxidized welding surfaces has been emphasized by many investigators, but the degree of "cleanliness" which is necessary to produce a 100 per cent efficient joint in an alloy steel part with no reinforcement has not been established.

It is believed that the very thin oxide film present on the welding surfaces of two freshly machined or polished parts may not be an important factor. Probably the harm comes from the oxides which form on the welding faces during the heating cycle, and from the oxygen and oxides which dissolve into the adjacent metal. Even if the welding faces are machined very accurately so that they fit together with virtually no clearance, it is quite probable that during the heating cycle sufficient differential expansion and warping take place to open a crevice into which oxygen from the atmosphere, and oxygen and water vapor from the welding flame, enter.

the Quality of

Pressure-Welded Joints in Alloy Steels

by C. B. Voldrich and J. L. Zambrow

It has been suggested that the oxide film or particles on the weld plane will disappear if, during the welding cycle, sufficient heat and time are provided to permit solution of the oxides into the adjacent metal. This may be true, but the possibility exists that the oxygen absorbed by the metal also exerts a deleterious effect on the strength of the joint. Many of the photomicrographs show weld sections etched with a reagent which, it is believed, brings out the presence of relatively large amounts of dissolved oxygen. These weld sections, when etched with nital or a similar reagent, show no sign of a weld line or band, and many show complete coalescence of the structure across the original plane of the weld faces. However, the same sections etched with the special reagent show a white line or band. It has been suggested by other investigators that, when the welding technique is such as to eliminate the presence of this white band, a series of good welds will result; but if the white weld line is not eliminated, consistently satisfactory welds will not be obtained.

The experimental work in this investigation has not fully established the character or influence of this narrow band at the plane of the weld, but considerable work with protective atmospheres suggests strongly that the weld quality can be improved by preventing oxygen from entering the joint during the heating cycle. Since it was found difficult to produce consistently satisfactory welds by variations in the welding schedule alone (temperature, pressure, upset, etc.), attempts were made to protect the welding faces from the atmosphere and the flame by metal plating, films of flux, lacquer and other compounds, and by forcing an inert gas such as helium, or a reducing gas such as hydrogen, through the joint during the heating cycle. The experiments with films and fluxes were not successful, but when protective gases were used, the strength of the welds was appreciably increased, although 100 per cent efficiency was not always attained (see Figs. 1 and 2). This technique has been applied with some success in the related flash-welding method, and it is quite possible that for the pressure welding of alloy steel joints, where top weld efficiencies are required, such protection of the welding faces during the heating cycle is desirable.

However, there are other factors which need to be considered in the establishment of a satisfactory pressure-welding schedule. One of the more important ones seems to be the amount of upset. Other things being equal, specimens which were welded with large upset distances were stronger than those with relatively short upset distances. The reason for this probably is that a large upset more completely disrupts the oxide films or oxygen-bearing layers which are formed prior to upset.

Other factors which seem to have a beneficial influ-

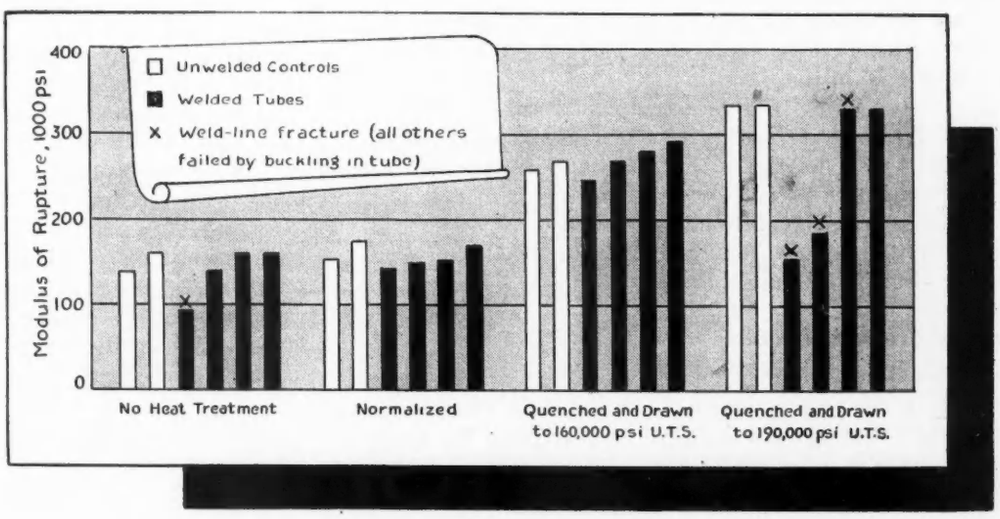


Fig. 2 — Evaluation of the strength of 16 pressure welded joints made with the square closed joint, dual pressure cycle, and with hydrogen in the tube to prevent weld line oxidation

ence on weld quality are the magnitude and duration of temperature. Weld strength improved, though not consistently, when the joints were maintained at the maximum temperature for a short period after upset, or when the conditions were such that the interior of the tube walls attained a relatively high temperature.

It was found during the course of these experiments that, to obtain consistent rates of heating and upset during a series of welds, it was necessary to exercise very careful control of the acetylene and oxygen flow to the ring burner. Early in the work, sensitive pressure regulators were installed to replace the standard pressure regulators originally purchased. This permitted the operator to maintain more uniform pressure settings from weld to weld; but even with the new regulators fluctuations in gas flow were experienced, and it was difficult to maintain constant welding conditions.

Weld-Zone Temperature

The data in the first progress report* showed that to obtain good pressure welds in thick-walled alloy steel tubing, high end temperature at the inside of the weld section was necessary. It was relatively easy to obtain the desired temperature on the outside of the weld section, but an important requirement was to maintain a minimum heat gradient through the wall thickness.

With the closed-joint method two factors, excessive flaring of the joint and excessive melting of the external surface, limited the temperature which could be obtained at the internal surface of the tube. With a mild flame or longitudinal oscillation of the burner, the heated zone extended a considerable distance from the weld line and caused excessive flaring at the joint. On the other hand, with an intense flame the rate of heating was increased and the plastic zone was narrower, but the external surface of the tube began to melt before the internal surface had reached the optimum welding temperature.

Several methods for increasing internal temperature were investigated, and are discussed here.

Dual-Pressure Cycle

To obtain a higher end temperature at the weld joint, with neither flaring nor external melting, a dual-pressure cycle was tried. A relatively low pressure (400 to 2000 psi) was maintained on the tubes until the weld zone had become plastic, and the pressure was then increased (to about 6000 psi) for only a few seconds, during which practically all the upset occurred.

In Schedule A (Fig. 1) such a dual-pressure cycle was used, with the single-row ring burner and a square joint. The upset was limited to ¼ in. by means of a positive stop. Owing to the low initial pressure, the interface was comparatively accessible to the flame gases and air in the tube, and as a result was considerably oxidized. No improvement in weld strength was obtained over similar welds made with the constant- or single-pressure cycle.

Additional dual-pressure welds were made with intermediate and high heat input, and with square and beveled joints (Schedules B, M, and O). Again, metallographic examination indicated no improvement over comparable constant-pressure welds (Schedules M and N). However, the dual-pressure cycle, in conjunction with a protective atmosphere and the two-row ring burner, produced some of the strongest welds made during the entire investigation (Schedule O).

Table I. Summary of Bending Tests of Closed-Joint Pressure Welds

Schedule	Atmosphere in Tubes	Type of Joint	Pressure	Upset Distance, Inch	Average Modulus of Rupture, psi (2)
A	Air	Square	Dual	0.25	64,000
B	Air	Square	Dual	0.50	138,000
C	Air	Beveled	Constant	0.375	139,000
D	Air	Square	Constant	0.25	144,000
E	Helium (4)	Square	Constant	0.25	151,000
F	Helium (3)	Beveled	Constant	0.50	169,000
G	Nitrogen (5)	Square	Constant	0.25	194,000
H	Hydrogen (4)	Square	Constant	0.25	200,000
J	Air	Square	Constant	0.50	216,000
K	Air	Beveled	Constant	0.50	217,000
L	Helium (5)	Square	Constant	0.25	240,000
M	Helium (5)	Internal Bevel	Dual	0.25	256,000
N	Helium (5)	Internal Bevel	Constant	0.25	269,000
O	Hydrogen (5)	Square	Dual	0.25	284,000

(1) See also Fig. 1.
(2) All tubes heat treated to approximately 190,000 psi ultimate tensile strength. Modulus of yielding for unwelded tube heat treated to 190,000 psi is about 330,000 psi.
(3) Gas passed directly from cylinder to tube.
(4) Gas dried in Ca Cl_2 drying tower before being introduced into the tube.
(5) Gas dried by chilling with dry ice and passing through magnesium perchlorate before introduction into tube.

Longitudinal Oscillation Of Burner

To offset the effect of inequalities in the circle of jets in the ring burner, all welds were made with the burner oscillating circumferentially 14 degrees, at 14 cycles per minute. Longitudinal oscillation, varying in length but always at 29 cycles per minute, was also used to equalize heating at the joint, but its principal purpose was to obtain higher end temperatures at the interior of the joint without excessive melting on the outside.

In the first tests, longitudinal oscillation was maintained throughout the heating period. However, this caused a wide heated zone and undesirable flaring, and the welds were thus less satisfactory than those made with circumferential oscillation only.

Subsequently, a schedule was used in which the burner was not oscillated longitudinally until the external surfaces of the tubes had approached the melting temperature. Longitudinal oscillation was then started, and continued for a relatively short period until a more nearly uniform temperature had been attained throughout the section. In this way, excessive melting at the outer surfaces was avoided. A similar procedure was used in schedules where large

(*Turn to page* 64, *please*)

* First Progress Report on WPB Research Project NRC-558, WPB-177, dated Jan. 15, 1945.

Observations

BY JOSEPH GESCHELIN

Cuts Cost

SINCE the introduction of the Greenlee process machine early in the war for the machining of aircraft engine cylinder heads, our industry has been interested in the adoption of process machines for parts required in large quantity. Recently, your editor viewed a private showing of a film describing applications of process machines for the machining of automotive parts such as rear axle housings, cylinder blocks, and other items. The manufacturer has not yet announced his products since the current activity is tied up with things not ready for publication. We can say, however, that the equipment is unique and holds promise of cost economies far greater than anything known to date. While we are not free to give the name of the producer, we shall be glad to refer inquiries to him.

Stainless Steel

AN enormous tonnage of stainless steel strip was used during the war for fabricated parts going into aircraft and aircraft engines. Today some of these facilities are being turned to normal automotive applications. One of the most interesting of these is the fabrication of stainless steel exhaust manifolds for heavy duty engines. The high temperatures and the sharp changes in temperatures combined with the relatively large size and mass of exhaust manifolds have long constituted a major problem. According to the fabricators of stainless steel the new type of manifolding meets the operating problems satisfactorily and should prove to be a boon to fleet operators.

Veto Corrosion

FROM the standpoint of owners of motor cars and heavy duty vehicles, the conventional mufflers and tail pipes leave much to be desired. Few of these last long enough to satisfy any user. Now that better materials are available, doubtless the producers of mufflers and tail pipes will be able to pick up the development programs started before the war, principally along the lines of adopting corrosion-resistant materials. There are many types of materials suitable for this purpose—aluminum-clad steel, coated steels, naturally corrosion-resistant low-alloy steels, and others. Higher costs certainly will be justified for heavy duty equipment.

Giant Castings

TECHNIQUES stemming from the war make possible the production of the so-called giant die castings in aluminum, and permanent mold castings in aluminum and magnesium. For instance, the entire crankcase and cylinder block structure of the six-cylinder Jack & Heintz engine is made in two halves by die casting. On the other hand, the new four-cylinder engine for the American Mathis will be made by the permanent mold technique. These and allied methods hold great promise in the manufacture of high performance aluminum engines for motor cars.

Time Saving Machinery

NO one in industry can deny that advanced machine tools of high productivity are a must in holding a ceiling on costs while paying the present scale of wages. Unfortunately neither the man-on-the-street nor even the average factory worker understands the role of mass production methods. It takes education to make the layman realize that high productivity goes hand in hand with high wages, lower costs, and a wider distribution of consumer goods. It takes education to make the worker realize that a machine capable of producing double the output of an existing machine, instead of reducing employment actually makes possible greater employment at higher wages and is instrumental in raising the standard of living. At the present time workers are inclined to hold down the productivity of a new machine on the theory that their jobs are in jeopardy. And that attitude is far removed from the actual facts. The National Machine Tool Builders' Association is in the process of initiating a program of education designed to reach the workers and the public in an effort to make these facts known. This program deserves the support of our industry.

Torque Converters

RECENT contacts with parts makers have proved to the writer that some outstanding work is in progress in the development of torque converters for motor trucks. One unit, now being road tested, is designed for light door-to-door delivery vehicles. Another is being groomed for the big trucks.

What Price Glory?

ON THE heels of the last phases of the invasion of Germany the government invited groups of technical men representing various industries to study developments in machinery and production techniques. Among these was a commission of machine tool representatives selected to study German machinery. One man was killed by enemy action, another received the Purple Heart. The general impression was that enemy machine tools were not up to our standards and held little of value to machine designers. However, the commission did turn in carefully considered reports on each type of machine with the understanding that these would be released for general publication and study. Although a year has elapsed since the reports were filed none has been released. For some unknown reason the material has been restricted. Evidently the war is not yet over in some quarters.

What's Coming In Plastics

THE creations of industrial artists in recent years have given an erroneous impression of the application of plastics in motor cars. Of course it looks mighty nice to have a completely transparent plastic envelope for the front end of a car. It may be argued that military aircraft used plastics for the nose and turrets. But there is no similarity in service requirements. The primary requirements for windshields are shatterproofness and the ability to withstand windshield wiper abrasion. To our knowledge the present types of plastics do not possess sufficient surface hardness to resist abrasion. That does not mean it can't be done in the future. We are told that some work is in progress to develop plastic transparencies for side windows with good prospects for success.

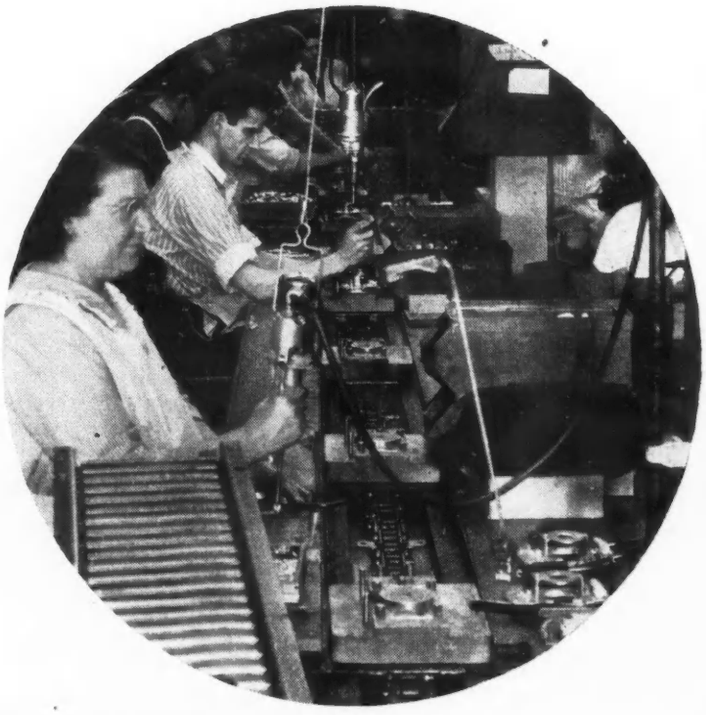
Scintilla's

By Joseph Geschelin

It was mentioned in the first part of this article, published in the May 1 issue of AUTOMOTIVE AND AVIATION INDUSTRIES, that the Scintilla organization has aimed at self sufficiency to the fullest degree, more so perhaps than in the case of most parts makers. This requires a large engineering organization including specialized sections not only for product design but for the design of tools and fixtures, and molds for die castings, for plastics and for rubber. In addition, Scintilla has specialists versed in the technology of ceramics, rubber, plastics, and die castings.

Engineering design facilities are supplemented by extensive laboratories for engineering research, wet chemistry, and metallurgy. Among these are a laboratory for the production control of all paints and solutions; a test laboratory for investigations of the heat range of spark plugs; an electronics laboratory containing the altitude testing chamber; and a control center for all instruments used in the plant. The main engineering laboratory has equipment for X-ray and spectroscopic studies; salt spray and humidity chambers, physical testing of basic materials, and a special Carrier-built apparatus capable of simulating any given set of atmospheric conditions for studies of spark behavior at the gap.

Moreover, since most of the tools, jigs, fixtures, and molds are made in the plant, Scintilla boasts an extensive toolroom, far larger than one will find in a plant of comparable size. This, too, is departmentalized so as to give special attention to items such



(Above) View of part of the high speed mechanized assembly line for the K-L flywheel magneto.

(Left) General view in portion of the heat treating department showing a large battery of Lindberg furnaces, the one in the foreground being loaded with aluminum selector frames for telephone equipment.

Self-Contained Setup

for Producing Ignition Equipment and Diesel Fuel Injection Systems

This is the 117th in the series of monthly production features

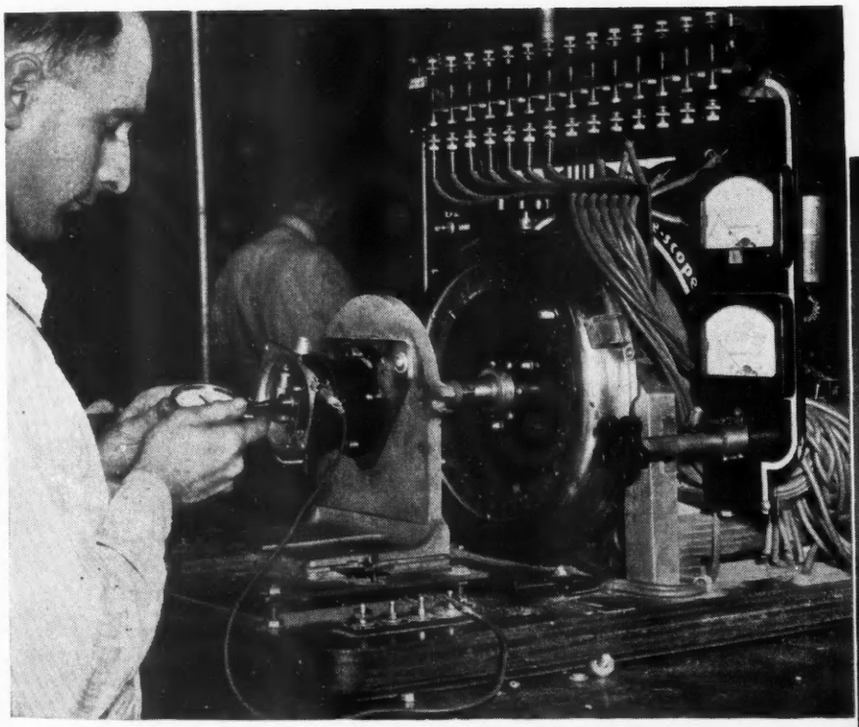
Part Two

as molds. There also is a special toolroom which serves as the engineering experimental department.

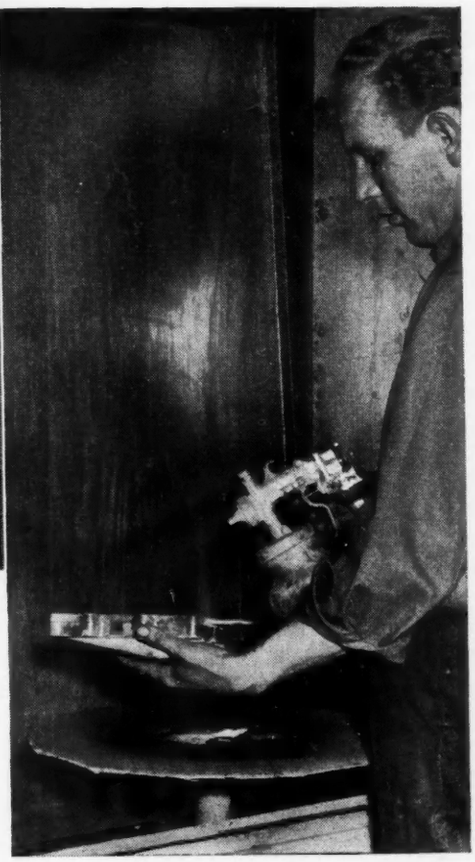
The toolroom is provided with an endless variety of equipment required for the multiplicity of jobs for which it is responsible, including Pratt & Whitney jig borers, and a large Keller machine.

One of the major points of interest in the toolroom is the constant temperature room in which tools and gages are checked. Atmospheric conditions are maintained at a temperature of 69 F and 50 per cent relative humidity. Among the equipment in this room are—a Vinco optical indexing head, Pratt & Whitney instruments, Sheffield gages, and Bausch & Lomb and J & L comparators.

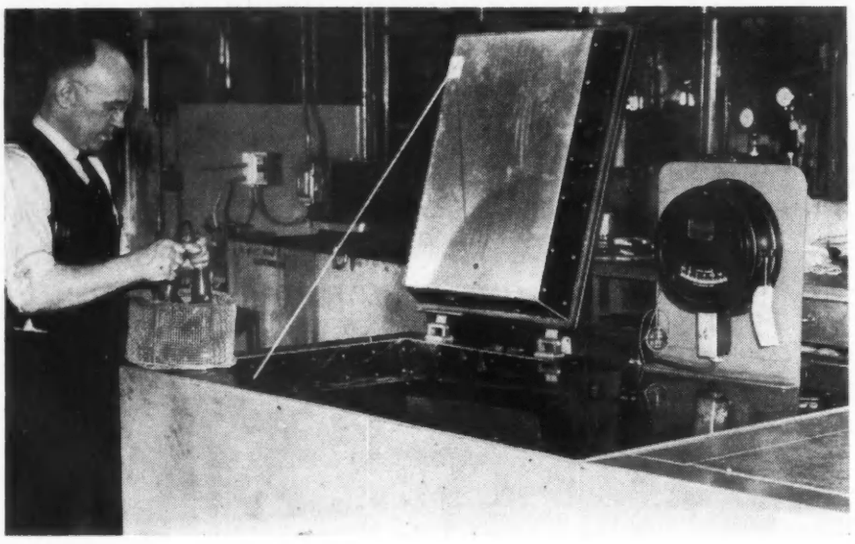
The toolroom also contains a tool grinding department with a special section for the cemented-carbide tools which are used extensively in the machine shop. The wider utilization of cemented-carbide tools is considered so important to the operation that they have an applications engineer whose



(Above) Example of electronic inspection equipment in the magneto department is this Weidenhoff Magneto-Scope on the final testing of WL-7A Jacobs timers.



(Right) One of a battery of Mahon Hydro-Spray booths found in this plant. Here the operator is applying a zinc chromate prime coat to a magneto cover.



Close-up of the Kold-Hold deepfreeze unit for stabilizing fuel injection nozzle holders. Temperature is held at minus 120 F.

chief responsibility is a constant and continuing study of tooling, leading to improvement in present tooling and the application of the proper grade of cemented-carbides wherever feasible.

Ceramics

Coming to the more specialified fields of activity, Scintilla has a ceramics research and engineering section for the development of ceramic bodies, emphasizing a unique type of aluminum oxide material for electrical insulation applications where high strength is required. The material developed here is one of the strongest bodies known, with excellent resistance to the common chemicals. No glazing is needed for most applications.

Since this is a relatively new project the equipment in the present setup is such as to facilitate research runs and semi-production runs simultaneously. It includes ball mills, filter presses, Stokes press, Simpson intensifiers, mechanical presses, and machine tools for shaping the preforms. A gas-fired experimental kiln is available for trial runs for small lot production. They have just completed the installation of a gas-fired tunnel kiln which will be available for large production lots in the near future.

Plastics and Rubber

The plastics department has its own engineering and research facilities and a section in the toolroom for producing molds. Molds are required in endless variety owing to differences in the nature of the parts, the type of material, and size of production runs. In current use are hand molds of compression type, semi-positive type, and hand transfer type; and semi-automatic molds of semi-positive and transfer types.

Among the commonly used plastics are the phenol-formaldehyde compounds in the general-purpose, medium impact, and high impact ranges. In addition, Scintilla is said to have been one of the major users of the Melamine type plastic during the war and is credited with a good share of the development of molds and molding techniques for Melma 592. This material is well adapted for use in the aircraft ignition field for high altitude operation owing to its high arc resistance, dielectric strength, and heat resistance.

Because of their high arc resistance and high dielectric properties, the plastics department produced a large volume of hard rubber moldings prior to the war. However, during the war these were replaced by synthetic hard rubber compounds of the Buna S type which have all the qualities of pre-war natural rubber compounds plus higher heat resistance.

For certain parts, including the new line of electrical connectors, where high quality soft rubber compounds are required, Scintilla is making parts from synthetic soft rubber compounds possessing high dielectric properties as well as resistance to oxidation and resistance to oil and grease.

The molding department is equipped with a large variety of presses ranging in capacity from 15 to 150 tons—in types such as toggle, hydraulic ram presses, up stroke and down stroke variations. In this group is a large battery of 50-and 100-ton Oilgear presses and a large number of the small Hannifin presses. In addition, there are two Stokes automatic molding machines for large runs. The equipment in this department is heated with electricity exclusively. Most presses have cycle controls and all have individual power sources.

Plastics compositions are fed to the molds in the form of standard preforms made in automatic presses in this department. Each of the larger presses is served by a Megatherm high frequency type unit for preheating the preforms. In some instances where small runs of small, thin preforms are used, they are heated by means of infra-red lamps. Supplementing this production equipment is a battery of electrically heated ovens with close temperature control used for improving the dielectric qualities of the various molded parts.

From the molding section the parts go directly to the adjacent molded parts machine department for such finishing operations as are necessary. To this end the department is equipped with a variety of general purpose machinery capable of handling the range of machining involved in the molded goods. Among the machines here are: Warner & Swasey turret lathes, Sundstrand mills, Delta drills, Brown & Sharpe grinders, Cincinnati grinders, Heald Bore-Matics, and others.

Process Department

The last major activity is the general processing department which is concerned with heat treating, painting, plating, and chemical processes. It has spe-

cialists for maintaining plating solutions, anodizing solutions, alkali solutions, checking paints, prescribing methods for tumbling and burnishing operations, as well as for furnace controls.

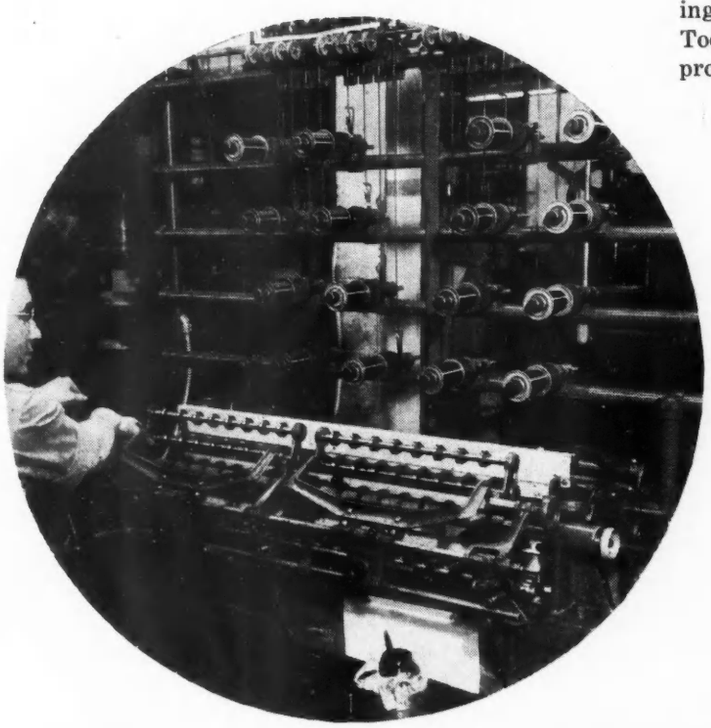
The heat treating section handles the following general operations—heat treating, tempering, annealing, nitriding, carburizing, torch brazing, silver soldering, aluminum brazing, induction hardening, copper brazing, etc. Among the equipment are included the following items, all electrically heated and atmosphere controlled—General Electric hydrogen brazing furnace, conveyor hardening furnaces, batch type hardening furnaces, salt bath hardening furnaces, Homocarb furnaces, Homo-nitriding furnaces, salt bath furnaces for nitriding tools, Lindberg Cyclone tempering furnaces, Lindberg Super-Cyclone furnaces, Lepel induction hardening machine, and oil tempering baths. In addition, there is a Kold-Hold deepfreeze unit for low temperature treatment of tools and metals, used primarily for stabilizing fuel injection system plungers. These are made of SAE 52100 steel and are treated at minus 120 F. All furnaces are controlled from a central control panel equipped with indicating potentiometer controls. Many of the furnaces have input controls.

One section of the department is equipped with a variety of types of the familiar Pangborn steel shot blasting machines for cleaning parts and, in addition, there is a special cabinet for shot blasting magnesium parts. On parts requiring special quality of descaling, they use a Bullard-Dunn unit of manual type. Too, there is a special Metallizing unit for spraying protective coatings of zinc, copper, iron, etc., according to specifications.

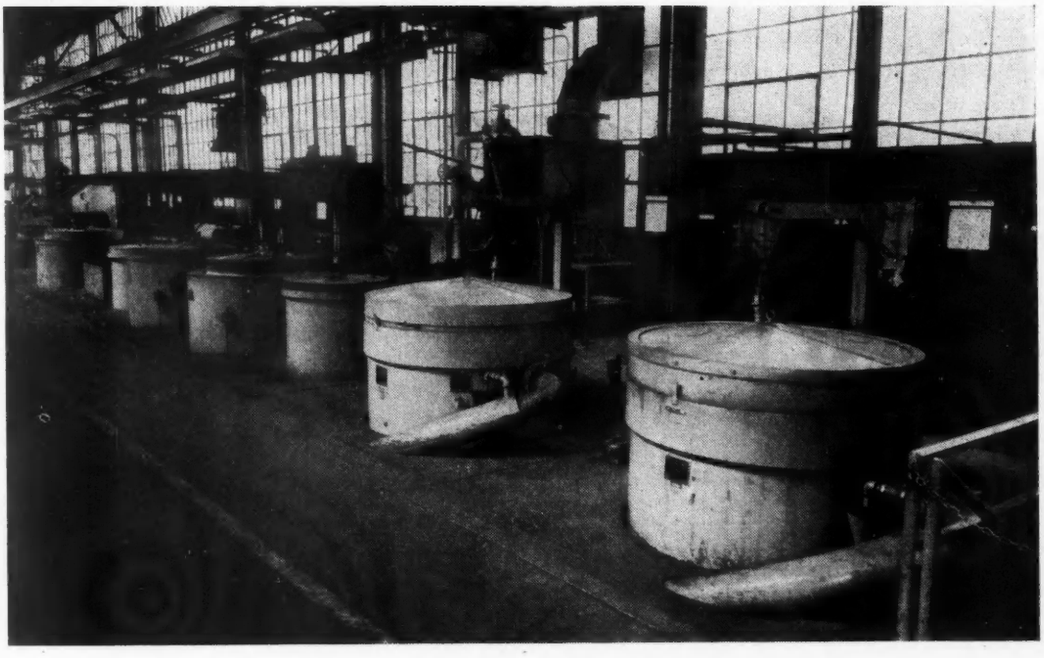
The latest piece of equipment in this department is a large Lester-Phoenix die casting machine for the production of aluminum and magnesium high pressure die castings.

The plating section is equipped to plate cadmium, chromium, copper, nickel, tin, and silver. Equipment consists of still tanks, barrel platers, and semi-automatic platers. For blackening of steel, there is an installation for the Dulite process. A special line is in operation for anodizing of aluminum parts by chromic acid anodizing. The anodizing tank has a fully automatic control panel.

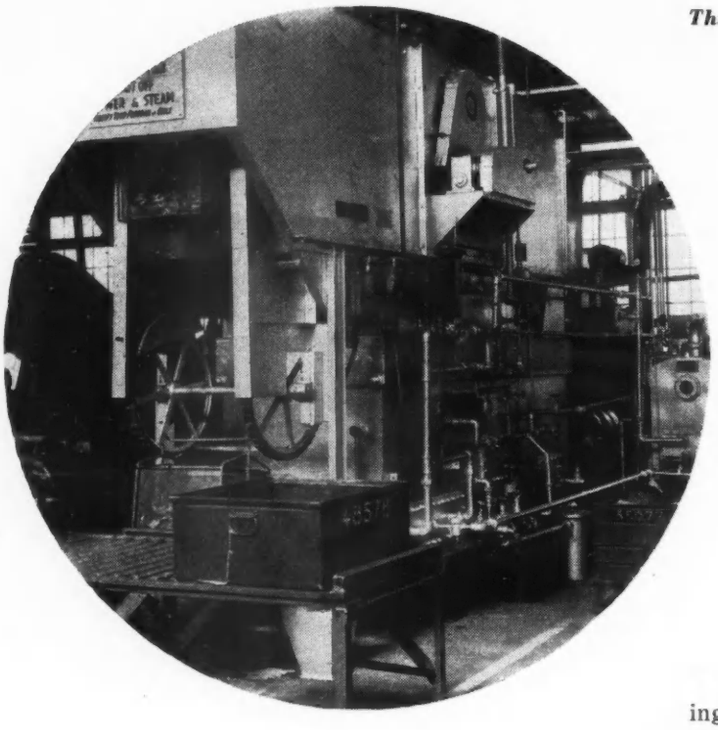
Two tanks, ceramic lined, are reserved for hard chromium plating of plastic molds, tools, and small production lots. Each tank is equipped with its own generator and



(Above) The coil and condenser department is equipped with modern multiple and single winding machines. Shown here is one of the universal automatic coil winders handling 16 coils in a single operation.



(Right) Another view in the heat treating department with a close-up of some of the Leeds & Northrup Homocarb furnaces.



This large Detrex degreasing unit for parts cleaning uses Permachlor solvent.

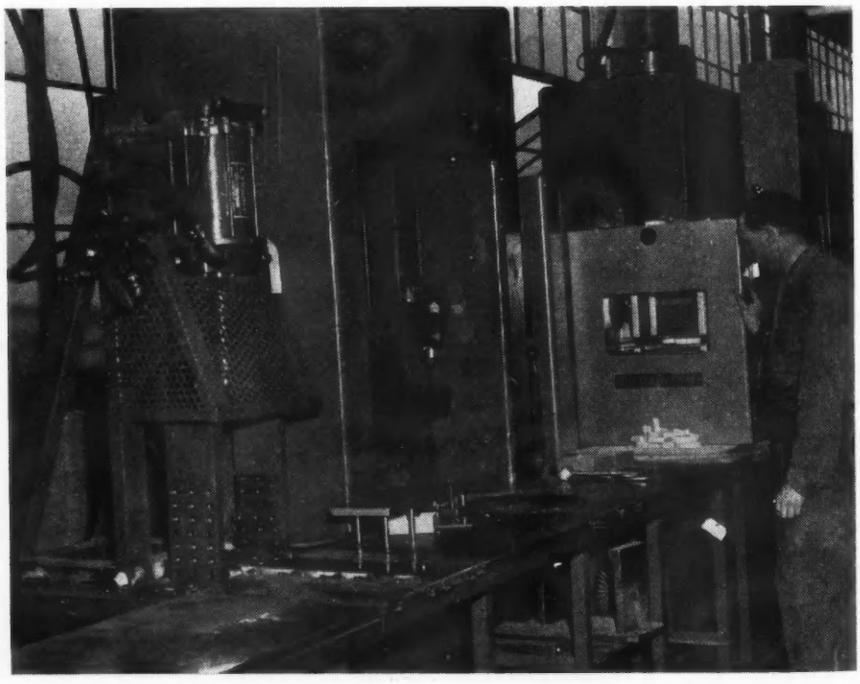
control panel. A stripping tank is one hand with its own generator. A small chromium solution tank for chromium plating of tool bits and cutting tools, with its own rectifier also is available. The exhaust systems are rubber lined or ceramic lined as needed. All tanks are raised off the ceramic brick floor and all drains run through open ceramic lined channels to minimize maintenance costs.

The paint shop has two process lines—one with tanks for alkali cleaning and water rinses for aluminum and steel parts, the other equipped with hydrofluoric acid tank, dichromate tank, nitric acid tank, and rinse tanks for applying surface protection for magnesium parts according to Dow Treatment Nos. 1 and 7. Parts after being prepared and primed with zinc chromate primer are baked in an electric conveyor oven, this being followed by applications of synthetic enamels, second bake, etc. All spray booths are of the Mahon Hydro-Spray type.

One of the newer wrinkles in the process department is the development of a technique of wet tumbling to remove sharp corners, burrs, etc., on all manner of parts both large and small. For this purpose they use carefully selected and graded stones which effectively remove burrs on the finest and sharpest surfaces without chipping or injuring the work.

Three wet tumblers are available for deburring of steel, aluminum and magnesium parts. These wood-lined barrels are filled with pre-determined amounts of parts, soap compound and granite chips of a certain size. Ordinarily, on aluminum and magnesium parts a half hour run provides a satisfactory finish. Steel parts require approximately one hour.

A battery of narrow type octagon burnishing barrels are used for burnishing of hardened steel parts. The cut down barrels are unlined whereas the burnishing barrels are wood-lined. In the cut down operation, a pre-determined load of parts, cutting compound such as emery flour, steel cones, and a small amount of sal-soda for prevention of rust, are loaded. The cut down runs from 6 to 24 hours. After removal from the cut down barrel, the parts are rinsed free from abrasives and the barrels are loaded with a predetermined amount of hardened burnishing cones, parts and liquid soap. The burnisher runs from 12 to 24 hours. These methods produce parts with a very smooth surface finish, and all sharp corners are round ed off. (*Turn to page* 102, *please*)



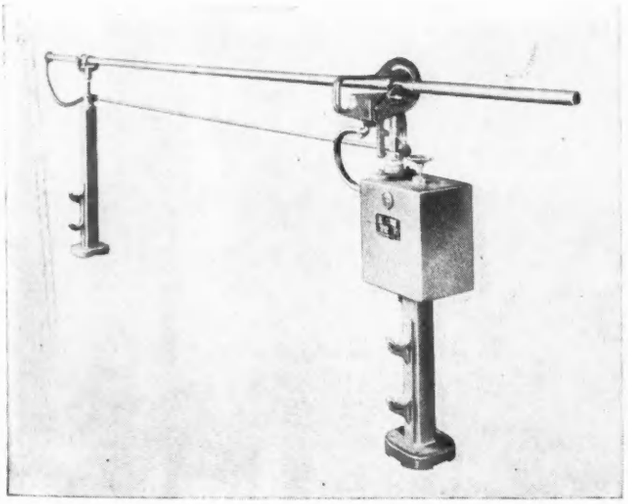
In the molding department—close-up of one of a large battery of Oilgear presses with the Megatherm electronic heating unit at the right. This press is molding Melmac coil housings.

New Production and Plant Equipment

THE Lipe pneumatic bar feed, manufactured by Lipe-Rollway Corp., Geddes and Lipe Sts., Syracuse 1, N. Y., consists of an air cylinder of sufficient dimensions to contain a full length stock bar, open at the forward end, adjustably mounted on two substantial pedestals. Within the cylinder is a piston having a ball bearing cup center which supports the free end of the stock bar. Air is supplied to the cylinder at low pressure, and forces the piston forward against the end of the bar, thus causing piston and bar to move forward instantly when the collet is opened. Movement is very rapid and bar is held firmly against stop until collet is closed.

With hand screw machines, when the piston reaches the forward end of the cylinder, the air pressure is automatically shut off and forward motion of the bar ceases. When the cylinder is reloaded the new bar pushes the remaining short length until it is completely used. A coupler tube which floats the spindle bore of the machine tool supports the forward end of the new bar and guides it into the collet of the machine.

With automatic screw machines the operation is as above except that a longer, tandem type piston is used. The forward end of the piston passes out of the feed cylinder into the spindle of the machine and stops at the collet jaw. The bar is fed from end to end, but the final remnant cannot be pushed out of the collet, thereby eliminating the possibility of tool injury. Stock may be set for facing cut when necessary.

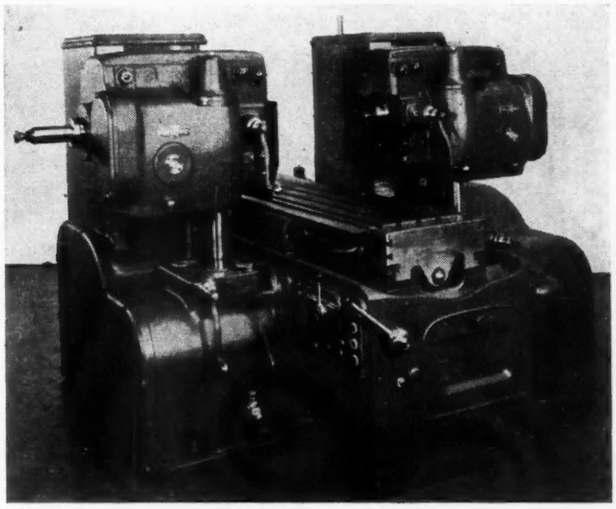


Lipe pneumatic bar feed

THE Cincinnati Milling Machine Co., Cincinnati 9, Ohio, announces a line of new Hydromatic milling machines, much heavier and more powerful, with increased cutting capacity and higher spindle speeds for high-speed carbide milling. Like the superseded models, the new machines are of bed-type construction, with automatic table feed cycles, and infinitely variable hydraulic table feeds.

Standard machines are built in plain and duplex styles, and in twelve sizes, No. 3-24 (24 in. table traverse, 7½ hp) to No. 56-90 (90 in. table traverse, 30 hp). More powerful motors in the proper frame sizes can be used for special application.

Principal castings—the bed, table, headstock, and spindle carrier—are exceptionally heavy. Tables are 2 in. wider than before, affording increased work and fixture clamping area. Ways are square gibbed. Along with the heavier headstock and spindle carrier castings, the drive is also much heavier, with wider faced gears, larger shafts and bearings, and a much heavier spindle. And because of the greatly increased size of the bull gear on the spindle, it provides a fly-wheel effect so desirable in high speed carbide milling. The entire speed transmission including the pick-off gears are spiral bevel or helical.



Duplex Hydromatic milling machine

An innovation in design will be found in the vibration damper construction of the overarm. This casting, much heavier than before, has a built-in unit which arrests vibration at the outboard end of the arbor.

Seven ranges of spindle speeds are available. The highest group (cataloged as "3rd high") ranges from 164 to 1225 rpm for small spindle carriers, 137 to 1000 rpm for medium spindle carriers, and 110 to 820 rpm for the large spindle carriers. Eight speeds are available within each range.

With the exception of four minor oil cups (eight on duplex machines) lubrication is completely automatic. Electrical controls are built into a compartment in the right-hand headstock. The door to this compartment is provided with an automotive type lock, and it also incorporates an externally operated disconnect switch which must be in the "off" position before the panel door can be opened. A small contact button built into the motor compartment automatically stops the motor when the hinged cover is opened. Controls include coils which reduce the current to 110 volts at the push button station.

Hydraulics do the work of starting

and stopping the spindle rotation. A small start-stop lever, located in the manual control group, releases the hydraulic pressure which engages and disengages the spindle drive clutch. Also included in the control lever group are the four position table control lever (rapid traverse and feed right and left), the table stop, and automatic spindle stop.

WARREN CITY MANUFACTURING CO., a subsidiary of the Federal Machine and Welder Co., soon will begin full-scale production of a new and complete line of all-steel welded presses in the company's plant at Warren, Ohio.

Present plans are to build a complete line of mechanical open back inclinable presses, ranging in size from 50 to 150 tons capacity, a series of mechanical and hydraulic metal-working presses with capacity from 100 to 1200 tons, and mechanical press brakes in sizes from 100 to 500 tons, and designed to handle lengths up to 24 ft.

Eccentric gear models will be made in both mechanical and hydraulic types. The press frame (solid or tie-rod) will be welded steel.

The slide will be welded steel, guided in long bronze-lined gibways. The slide will be adjusted by a motor equipped with a magnetic-type brake for automatically locking the adjustment. Pneumatic cylinders will counter-balance the weight of the slide and dies.

These models will be double-geared twin drive with bull gears of the eccentric type, rotating on a straight pin. All gears will be steel, the high speed gears being herringbone and the bull gears being spur. The gears will operate in an oil bath.

The clutch and brake unit will be the friction-disc, mechanically-interlocked type, with the clutch being air-actuated and the brake, spring actuated.

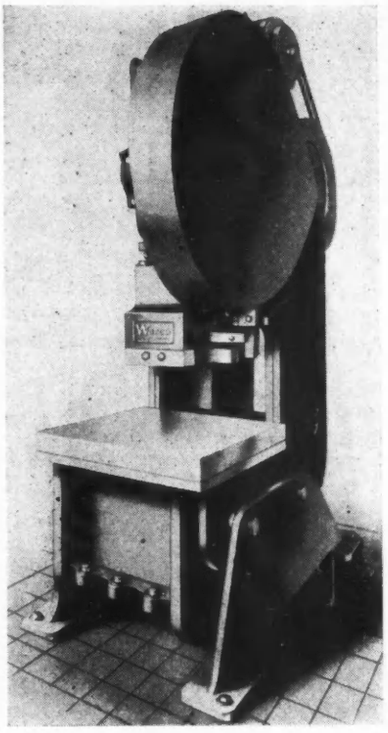
The clutch will be controlled electrically by push buttons with a selector switch having "off," "long," "short," "inch," and "continuous" positions. The control also has a non-repeat feature.

Gears and all bronze-bushed shafts will be lubricated by oil supplied by a small pump. The backshaft and gibways will be greased from a point convenient to floor level.

The eccentric gear presses will have a stroke range from eight to 36 in. and a between housings range of 42 to 156 in. and longer. Die cushions will be available as built-in units, guided in bronze-lined gibways in the bed.

"Warco's" OBI models will embody advantages usually found only on larger presses. Frame construction will be similar to eccentric-gear models, affording maximum rigidity. The slide will operate in extra-long gibways necessary for proper die alignment.

The crankshaft will be made from a high carbon heat-treated steel forging having an extra large crank pin. All crank bearings will be bronze bushed and of split cap design.



One of the series of "Warco" open-back inclinable presses

The clutch and brake unit will be the same as on the eccentric gear models. The flywheel and clutch and brake unit will be mounted on the backshaft between the housing plates of the body. The clutch will be electrically controlled by push buttons having a selector switch for "once," "inch," and "continuous" operation.

The crankshaft, backshaft, and gibways bearings will be lubricated with grease from a point convenient to floor level.

OBI models will be of mechanical design with a stroke range of four to 14 in. Provision will be made for mounting die cushions in the bed. Cushions will be available for factory installation or at some future time.

THE Hydraulic Press Manufacturing Co., Mount Gilead, Ohio, announces two new high pressure die casting machines for casting magnesium, aluminum and copper alloys. Mold clamping, metal injecting, core pulling and ejecting units are all operated by direct hydraulic means.

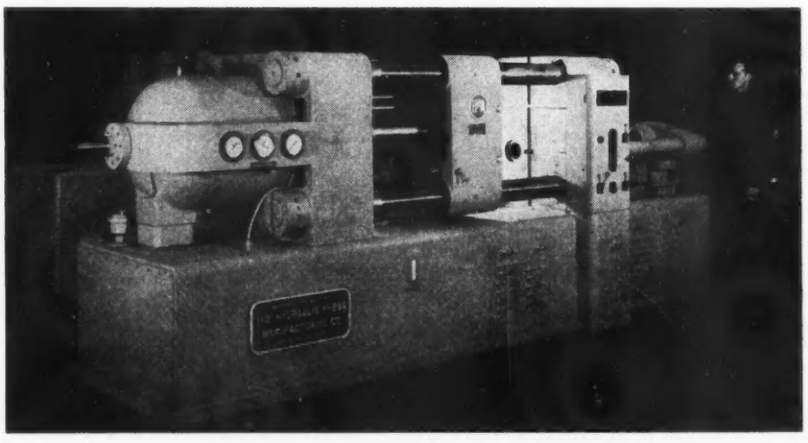
High pressure die casting employs the cold chamber process. The metal is sustained in the molten state in a conveniently located holding furnace. The operator ladles the metal into a slot opening into the injection cylinder, commonly called the "cold chamber." The injection plunger advances, displacing the metal in the cylinder and forcing it into the closed mold.

Although some zinc die castings are made by the "cold chamber" process, the alloys normally cast by high pressure machines are aluminum, magnesium and copper. Larger castings with better physical properties can be produced by the high pressure method. The castings are dense, have a more uniform structure, resulting in a much lower percentage of scrap loss.

H-P-M high pressure die casting machines have injection capacities from 12½ to 100 cu in. per cycle. Injection pressures from 6,000 to 50,000 psi are available, depending upon plunger diameter. Two standard machine models, the 400-A (aluminum) and the 400-M (magnesium), are now being produced. The basic difference between these two models is the speed of the plunger. On the magnesium machine (model 400-M) the plunger is actuated by a nitrogen accumulator or "bottle." This provides injection speeds up to 7,200 in. per min. Due to the fact that the injection speed is adjustable, the magnesium machine can also be used for die casting other alloys. The standard aluminum machine (model 400-A) employs straight-line hydraulics, the injection ram being directly connected to the H-P-M Hydro-Power radial pump. Maximum injection speed of the aluminum machine is 750 in. per min.

One of the most outstanding design features of these new H-P-M high

(*Turn to page* 98, *please*)



H-P-M high pressure die casting machine

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New Products for Aircraft

Electrically-Heated Rubber for Intake Cowls

The use of "hot rubber" to help keep airplane engines cool is revealed in an announcement by the B. F. Goodrich Co., Akron, Ohio, that it is now supplying electrically-heated rubber for the intake cowls of jet-propelled or jet-assisted airplanes. Paradoxically, the rubber facings aid the cooling system by keeping ice away.

The jet cowls direct the flow of air from the plane's leading edge over the starter, generator and other engine accessories to keep them cool. Accumulations of ice in a cowl can stop this cooling air flow as effectively as a woolen blanket, and to meet this problem the company has now produced electrically-heated rubber linings for the insides of jet cowls. They not only prevent ice formation but also serve as effective anti-abrasion shoes.

Hamilton Propeller Has Square-Tipped Blades

A new type of propeller blade, similar in appearance to the vanes used on windmills, will soon make its appearance on some of the newest American transport aircraft, according to Hamilton Standard Propellers Division, United Aircraft Corp., East Hartford, Conn. Square tipped instead of elliptical, and almost rectangular in shape, the new blade has been developed to meet the advances in airplane speed engine power made during the war.

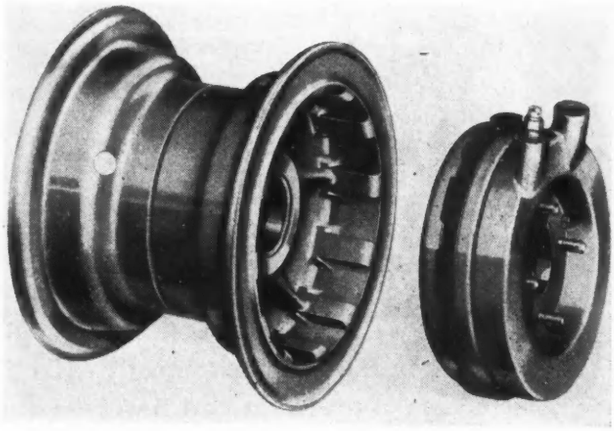
The square tip, because it carries the airfoil section for the blade's entire length, is said to make it unnecessary to distort the airfoil design at the tip as was required with the round-tip blade. Further, it permits the use of a thinner, less cambered airfoil at the tip.

Hamilton Standard propeller on Army bomber

Firestone Introduces New Aircraft Brake

A new aircraft brake, introduced by the Firestone Aircraft Co., Akron, Ohio, is said to overcome excessive temperature build-up. Development plans include application of the new design to brakes from 100,000 to 4,000,000 ft lb, kinetic energy capacity. Such brakes would fit on small private planes and giant bombers and transports.

Low operating temperatures of the Firestone aircraft brake are made possible by using fabricated stator discs having as a friction surface, a thin sheet of high conductivity copper, backed up by a disc of light aluminum alloy. This aluminum alloy disc has not only high conductivity but extra heat storage capacity. The low resistance to heat travel causes a very flat heat gradient resulting in sub-normal temperature on the friction surface and much higher than normal temperature on the outer radiating surface. This is said to result in a higher overall rate of heat dissipation from the brake. The storage capacity takes the peak temperatures out of sudden, excessive brake applications.



View of Firestone brake as removed from airplane wheel

Structurally, the brake is classified as a conventional, single disc brake. A magnesium casting containing the hydraulic annular piston unit also acts as the base for all the major parts of the brake and is anchored to the airplane torque flange. On this casting, between the piston and the back thrust plate, a disc is mounted which is free to move laterally, but fixed with this casting against rotation. Between the stator disc and back thrust plate is a disc of molded brake lining with lugs on its outer circumference which engage with notches in the wheel causing it to rotate with the wheel. When the hydraulic pressure is applied this rotating lining disc is squeezed between the fabricated stator disc and back thrust plate to develop frictional brake torque. When the hydraulic pressure is released, release springs, which are built

(*Turn to page 72, please*)

ONE 'MORE STRAW—ONE LESS CAMEL!

Many centuries ago the weight of one last straw broke a camel's back. Thus somebody's artless optimism about the strength of a vital part wrecked a perfectly good materials handling system.

Today it is plain, cold fact that ignoring the depressing effect of low temperatures on the impact strength of vital steel parts can be a short cut to a long line of avoidable, costly troubles.

The solution for the problem in the fable was less load or more camel. For the modern problem the answer is a molybdenum steel that combines the deep hardening and freedom from temper brittleness necessary to provide good low temperature impact strength.

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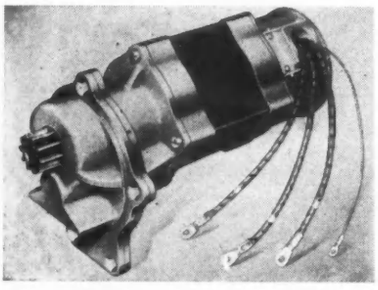
New Products

Starter-Generator Saves Weight and Space

A new EEMCO starter-generator—a direct-drive, light-weight combination unit for aircraft, marine, and automotive engines—is now being tooled for large-scale production, by Electrical Engineering and Mfg. Corp., 4606 Jefferson Blvd., Los Angeles 16, Cal.

The production model designed for use on small aircraft has been refined even further than the original starter-generator. Weight has been pared down to 17 lb. Another refinement is the reduction of over-all length to 9½ in., to allow greater clearance between the starter-generator and the engine fire-wall. The output of the generator, 35 amp at 14 volts, permits full use of radio and other electric accessories with only a small storage battery.

Starter and generator are combined in one unit, the same windings serving for both. The starter gear reduction



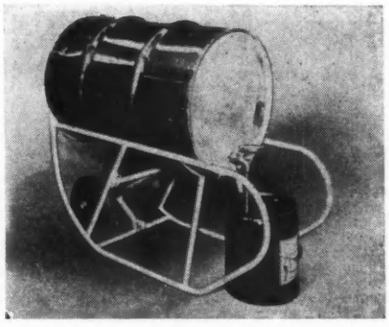
EEMCO starter-generator

for cranking is 23-1; the generator reduction is 2½-1. Maximum starting torque is 160 ft-lb. Generator output is 500 watts, continuous duty. A torque-limiting clutch, built into the unit, prevents damage to the unit from backfire, under all conditions as outlined above. Coupling to the engine crankshaft eliminates need for belt or chain drives. Adapter mounting brackets are available for the most popular makes of engines.

Combination Truck-Rack

A new combination truck-rack, for carrying and storing 55-gallon drums, is being introduced by Aircraft Mechanics, Inc., Colorado Springs, Colo. Called "Super-Toter Drum Truck-Rack," the tubular steel assembly is easily loaded by one man. The wheel unit is designed to swing so that actual lifting of the drum is delayed until entire weight is balanced over the wheels and maximum mechanical advantage obtained.

The truck-rack assembly features its



Combination truck-rack made by Aircraft Mechanics, Inc.

detachable wheel unit. One wheel unit can serve many racks, if desired, attaching or detaching quickly so that a series of racks may be used intermittently as pouring stands or drum trucks. A detachable coster unit also is available as an accessory item. This unit attaches and locks easily. It permits the drums to be rolled on the rack unit so that spigot can be quickly positioned for pouring. All joints of the drum-truck are welded; weight of the entire assembly, less accessory caster unit, is 44½ lb.

Du Pont Develops New Automotive Finish

Du Pont chemists have developed a new automotive finish—"Duco" Metalli-Chrome nitrocellulose lacquer — which tests are said to show is extremely durable. It is believed also to surpass in beauty any coating yet to appear on automobiles. Utilizing new pigment materials and manufactured by a patented process, Metalli-Chrome provides rich, lustrous colors and color effects never before produced. This appearance results from the high degree of translucency of a Metalli-Chrome film. Light penetrates the film and is reflected to the eye from underneath instead of rebounding from the outer surface as it does when it strikes a conventional coating. The glowing effect is enhanced by small particles of aluminum flake which act as tiny mirrors, diffusing and reflecting light within the film.

These translucent metallics present to the eye a startling color variation as the lighting alters or the angle of vision shifts. For example, a definitely reddish-brown changes all the way over to an equally definite gray-brown. Burnished gold and shades of bronze are in the gamut of these colors.

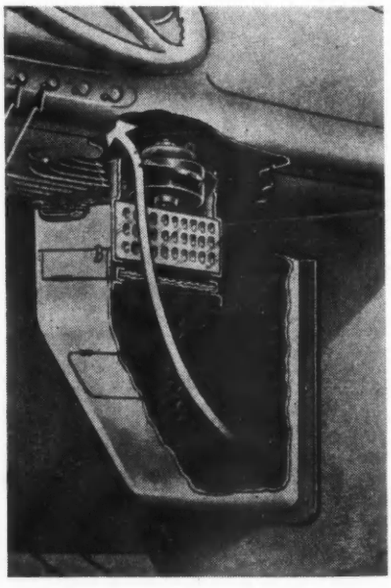
Metalli-Chromes are applied by the customary lacquer finishing. procedure. They are available for original factory finishing as well as for shop refinishing. The Du Pont Co. will tender patent licenses to manufacturers desiring to produce similar automotive finishes.

New System for Heating and Ventilating Truck Cabs

Recognizing the interest on the part of fleet operators in driver comfort in motor trucks, the Thermo-Aire Div., Evans Products Co., Detroit, Mich., has announced the Evans-System for truck cab heating and ventilating. The heart of this system is an Evans "Airfoil" fan with motor drive which can be incorporated into the design of cabs by the vehicle producer. Because of the special features of cab design required for the installation, the Evans-System cannot be installed economically in an existing cab.

Secret of successful operation is said to be found in the exclusive "Airfoil" fan which has the ability to handle a large volume of air against the pressure necessary to do a complete job with the lowest possible drain on the battery. Another feature is the use of a large heater core.

The fan and core assembly is installed in a suitable chamber on one side of the cab, communicating directly with a weatherproof ventilator or louver in the side of the cab. The assembly can be located in any convenient place to suit the arrangement of the cab and on either side. It can be tapped



Evans truck cab heating unit

FOR
LEAK-PROOF, PRESSURE-TIGHT
ASSEMBLIES

USE PERMATEX FORM-A-GASKET on NEW gaskets...and on OLD gaskets!

Form-A-Gasket No. 1 (a paste) sets fast but not too fast for use on large surfaces. It dries hard but never becomes brittle. It's a swell product for making pressure-tight, leak-proof, permanent unions even when surfaces are warped.

Form-A-Gasket No. 2 (a paste) sets a little slower than No. 1. It dries to a tough, pliable layer with plenty of "cushion". It resists high pressures and very readily disassembles.

Aviation Form-A-Gasket No. 3 (a heavy, brushable liquid) sets itself into position and dries to a tacky paste. It will not run even when heated to 400° F. Nor will it become hard or brittle at temperatures down to 70° below zero. It's a great, all-around product!

ALL TYPES OF FORM-A-GASKET PRESERVE ALL TYPES OF GASKETS!

PERMATEX COMPANY, INC.
BROOKLYN 29, N. Y., U. S. A.

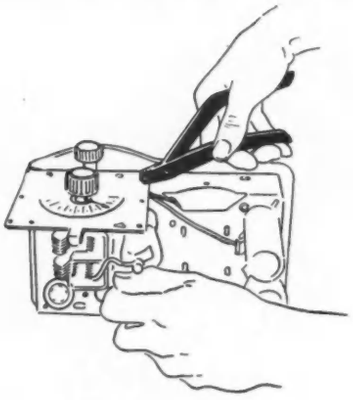
anywhere to deliver air at any number of desired locations.

In contrast to the conventional means for heating and defrosting, the new system incorporates a large series of small slots in the instrument panel, extending the full width of the panel and around the sides, if desired, so as to provide complete defrosting of the windshield and the side windows. In addition, outlets can be provided at points under the panel for directing heated air to the seat and floor, and over the pedals.

The system is designed to operate with automatic temperature control through the installation of a positive acting thermostat, adjustable by the driver.

Light-Duty Gun for Blind Rivets

An inexpensive, light-duty blind rivet "gun," the Cherry Jr. Riveter, has been added to the Cherry line of blind riveting tools. Made by the Cherry Rivet Co., 231 Winston St., Los Angeles 13, Cal.



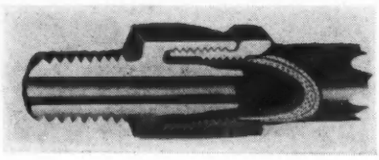
Cherry rivet gun

The Jr. Riveter, a one-hand, plierlike tool that installs the rivet with a simple "pull," is made especially for small fastening jobs. It installs a new 3/32 in. diameter blind rivet, provided in three grip lengths. The rivet is the tight-clinching, pull-through hollow type having generous shank expansion.

Reusable Hose Couplings

A complete line of attachable-detachable reusable metal couplings for flexible hose lines is now in production at Resistoflex Corp., Belleville, N. J. Combined with any flexible hose—preferably with compar-lined gas-oil hose because it is impervious to gasoline, organic solvents and oil—these reusable couplings properly attached can be trusted never to let go or vibrate loose, according to the manufacturer. They are easily and quickly attached or detached and can be used over and over again, with end-wrench assembly done on the spot.

The coupling nut threads onto the hose, with coupling shell compressing the hose end into a safety-seal gasket. With keep-true threads, the fitting has a long even grip on the hose, the double bell shape of nut allowing hose to flex without cutting. The heavy body of the fitting prevents crushing or distorting of the line.



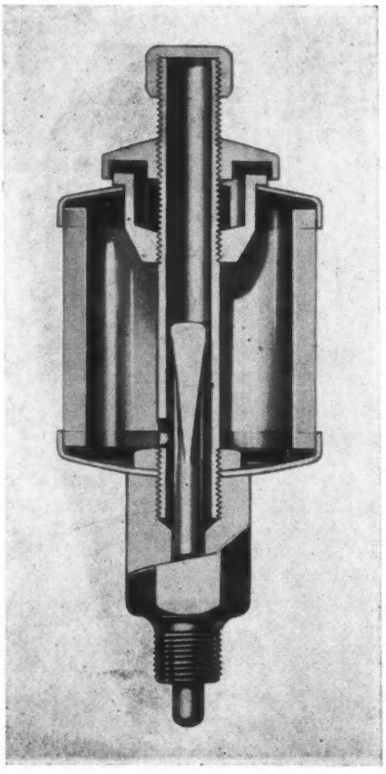
Resistoplex hose coupling

Dimensionally Stable Plastic Slide Rule

To fill the need of a slide rule of greater dimensional stability, the Charles Bruning Co., 4754-10 Montrose Ave., Chicago, 41, Ill., has placed on the market a new 10-in. slide rule. This slide rule is made of a plastic material that is said to have remarkable dimensional stability. The precision graduations are not affected by temperature change. The glass indicator is mounted in a polished stainless steel frame that holds it firmly in place.

The CI scale shows numerals and gradations in red to provide ease of reading. To permit the widest possible range of service, A, B, CI, C, D, K, S, L and T scales are shown on the rule. The beveled edges of the rule are graduated in inches and centimeters.

The tension on the slide is adjusted by four screws on the back of the rule. The indicator glass may be readily replaced in the event of breakage.

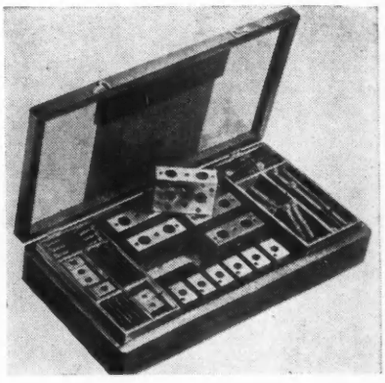


Oil Rite bottle order

Set-Up Blocks Replace Conventional Parallels

A new idea in 3-way parallel set-up blocks, which build up to twelve different heights and take the place of a large number of conventional parallels, has been originated by the Moore Special Tool Co., Inc., Bridgeport, Conn.

The complete set consists of six each of two sizes, 1 in. by 2 in. by 3 in. and ⅞ in. by 1¼ in. by 1½ in., packed in a mahogany box for operator convenience in working out any combination of sizes for any particular application. Each block can be used in any of its three dimensions.



Moore 3-way parallel set-up blocks

Moore 3-way parallel set-up blocks are drilled and counterbored for bolting to the machine table or faceplate and will not slide off when attaching work to a vertical surface such as a microsine plate, a rotary table when used for radial spacing, or a lathe faceplate. Tapped holes on all three sides for supplementary straps permit work to be supported parallel or perpendicular to working surfaces.

Vibrating Rod Bottle Oiler

A vibrating rod bottle oiler which is automatic in action and refillable without removal from its installation is now being delivered by Oil Rite Corp., 3426 So. 13 St., Milwaukee, Wis. It is used on plain sleeve bearings, line shaft bearings, jack shafts, and spindles where light or medium oils are satisfactory.

Oil is fed from an airtight reservoir through an oilport to a feed rod which slides freely in a closely fitted hole in the base and rides lightly on the journal. A slight vibration is caused by the directional drag of the rotating shaft on the feed rod, resulting in a pumping action. As the bearing becomes warm, heat is conducted through the rod to the reserve oil, causing the air in the reservoir to expand. The pumping and thermal action force oil to creep slowly down the feed rod to the bearing. Since the feed rod is lubricated where it rides the shaft, there is no wear on the shaft. When the shaft is not in motion, vibra-

(*Turn to page* 68, *please*)

SARAN

Let's work it out together

Success in plastics is best measured in end products. It calls for the combined efforts of manufacturers, designers, fabricators and raw material producers. Dow is ready to do its part. Save time and money—call on Dow and *get the most out of plastics*.

The Dow Plastic

for "wear-conditioned" upholstery

You can give upholstery long-wear standards in keeping with other parts of the American motor car with fabrics woven from Saran (pronounced Sah-*ran*).

Textiles made from monofilaments of this rugged plastic, produced by Dow, have assured serviceability. Saran measures up to the automotive industry's aim to provide constantly renewed satisfaction in motoring.

Countless automobile owners can testify (after being forced to drive the same car for years) that age tells quickly on upholstery. Saran writes off age. Its smooth, pliant surfaces give more wear than is really needed.

Saran won't scuff or snag. It won't stain or rot. It's unaffected by water. It's impervious to most chemicals, including acids. It won't absorb dirt. A damp cloth will keep its beauty at par.

Investigate Saran! Find out how this and other Dow plastics can help make better automobiles!

PRESENT AND POTENTIAL USES: Plating masks; chemical apparatus; pump parts; valves and valve parts; name plates; meter parts; paint brush handles; insulation; stoppers; funnels; bottles; closures; plumbing parts and equipment; wire coating, etc.; pipe and tubing for installations requiring chemical and corrosion resistance; monofilament for textile fabrics.

PROPERTIES AND ADVANTAGES: Resistant to chemicals, abrasion, corrosion, water, and moisture; good electrical insulator; excellent thermal insulator; nonflammable; tough; flexible; dimensionally stable; not recommended for installations requiring temperature resistance above 170° Fahrenheit; tends to brittleness at very low temperatures.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • Chicago
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PLASTICS

ETHOCEL • ETHOCEL SHEETING
STYRON • SARAN • SARAN FILM

NEWS *of the* Industry

Coal Strike Hits Industry After Production Increase in April . . . Supply Situation Still Critical . . . Many Labor Issues Unsettled . . . South America Major Export Market . . . Effect on Industry of Studebaker Model Change Still in Doubt.

THE effects of the coal strike hit the automobile industry early in May when Ford announced that practically all manufacturing departments of the company would be closed indefinitely beginning May 10. Assembly lines were to run until May 15. After months of costly improvising Ford has been unable to make any appreciable gains in production. In fact, output had decreased in the last two weeks before the shutdown because of parts shortages. The final straw was the freight embargo and the severe curtailment of power in the Chicago area, both due directly to the coal strike. Also the company reported that 42 parts suppliers were on strike, and the Chicago brownout limiting production to 24 hours per week affected 40 more, making it impossible to continue.

Chrysler Corp. reported it probably would have to suspend operations by the week of May 15. General Motors, in somewhat better position because of reserve inventories, indicated it might be able to run through the week of May 15, but if the freight embargo continues probably will be forced to close then. Receipts of certain critical parts are on a day to day basis, and for this reason some assembly plants may close down before other manufacturing operations, possibly by the middle of the week.

A Nash spokesman says that the company is hoping to keep running until the end of the month. Hudson and Packard have indicated that they both have enough coal to keep going and fair reserves of parts, but the freight embargo or shutdowns of suppliers might force curtailment soon.

Rate of Production Up During Month of April

The upward trend of automotive production during April, ending up with an output estimated at around 60,000 for the last week of the month was encouraging, but it should be noted that it was the result of certain factors that could lead to misleading conclusions. The principal cause for the rise was that General Motors and Packard returned to the production lineup with accumulated reserves of parts and supplies built up during periods of enforced idleness. These two companies were in a position to increase their daily production, at least for awhile, whereas others which have been in production for several months were in a much more precarious condition because of a limited flow of parts. In April, daily production figures actually had declined at Ford at the end of the month in comparison with the first week. Nash output fluctuated during the month but production the last day of April was exactly the same as the daily average for the first week.

Suppliers Hold Key To Increased Production

The experience of Hudson, Willys, and Buick in the recent strike at Midland Steel Products Co. illustrates the important role played by a key supplier in automobile production. The first two companies were closed during April for lack of frames and Buick was feeling the effects shortly before the strike was settled. Until all major parts suppliers have settled their wage problems, a constant threat will hang over the automobile industry. In some cases a parts strike may only hamper assembly operations; in others it may close them down altogether.

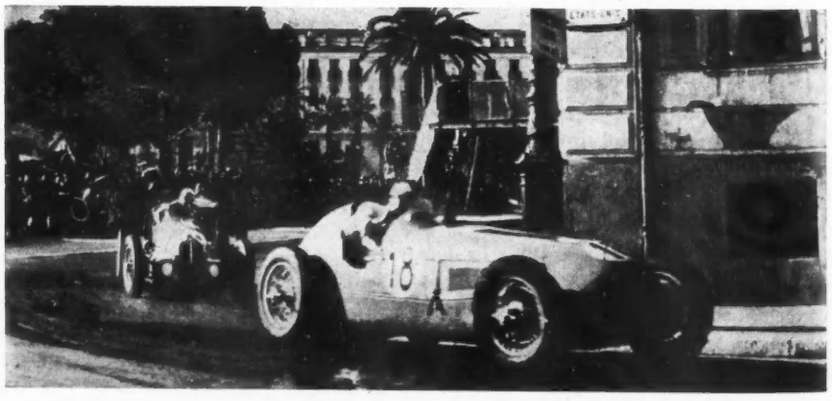
Many Labor Issues Still Pending

The labor situation in the automobile industry still is considered to be in a sleeping dog category. While the wage issue has been disposed of for the time being by the major manufacturers, the pot is simmering in the UAW-CIO kitchen and only a little more time will be required to bring it to a boil. In two instances already, large companies have been threatened with strike action—Ford, in an attempt to force payment of an 18-cents-an-hour increase before the contract is ratified, and Chrysler because of union charges that the Corporation is retiring men over 65 years old. While neither of these threats is considered very serious at the moment, they signify the truculence and hard-hitting tactics which the union is continuing to employ.

Under the new leadership of Walter Reuther, the UAW-CIO has laid down a policy program that is disquieting to the automobile industry. After months of turmoil and bickering, it was hoped that something like harmonious relations could be restored. However, the new policy line calling for a determined drive for retirement plans, an organizing campaign by the competitive shops department, equalization of rates for skilled trades in all captive and independent shops, a strong bid to exclude wage rates from contract negotiations and to consider such rates simultaneously for all companies as a prelude to industry-wide bargaining, and a forceful attack on wage incentive systems, holds promise of nothing but fur-

(*Turn to page 62, please*)

First Postwar Running of "Grand Prix"



For the first time since the war, the "Grand Prix International" was run at Nice, on the French Riviera. The race was won by Viloresi, an Italian driver, at an average speed of 104 km per hour. This view of one of the sharp turns on the course shows the winning driver running in second position, Acme photo.

Finest facilities for designing and making pistons, sleeves and rings at your service now

Four wet type sleeves are bored simultaneously on this machine.

SINCE 1911 leading automotive engineers have recognized Sealed Power factories, laboratories and personnel as being unequalled in this industry. Today Sealed Power facilities are the finest in all our 35-year history. You are invited to make full use of these Sealed Power resources to help your good engines even better.

SEALED POWER CORPORATION

Muskegon, Michigan • Stratford, Ontario

Keep Your Savings Bonds! Get $4 for $3!

SEALED POWER PISTON RINGS

PISTONS — CYLINDER SLEEVES

PUBLICATIONS AVAILABLE

Publications listed in this department are obtainable by subscribers through the Editorial Department of AUTOMOTIVE AND AVIATION INDUSTRIES. In making requests give title above the item concerning the publication desired, the date of issue in which it appeared, your name and address, company connection and title.

Airport Electrical Equipment

Westinghouse Electric Corp.—56-page booklet, Airport Electrical Equipment, gives typical lighting plans and wiring diagrams for all classes of airports. Distribution equipment described includes fuse cutouts, relays, regulators, transformers, panelboards and control panels. Section on lighting equipment covers beacons, floodlights, boundary and obstruction lights, ceiling projectors and other units. A section is devoted to associated airport equipment and includes special equipment for small airports, alternate distribution apparatus, battery chargers, engine starters and stand-in power plants.

Marine Engines

Gray Marine Motor Co.—New illustrated booklet containing specifications on Graymarine gasoline engines for 1946.

Metal Heating

Salem Engineering Co. — 16-page booklet, Engineered Heat, designed for engineers and production men, contains descriptive information on circular soaking pits, various types of heating furnaces and auxiliary equipment developed by Salem. Includes installation pictures and easy-to-use tables and charts on temperature conversion and thermal efficiency of fuels.

Cloth Tape

Chicago Show Printing Co., Mystik Tape Div.—New folder describing and illustrating the properties and specifications of Mystik self-stik cloth tape, a waterproof sealing tape.

Electrostatic Processes

Harper J. Ransburg Co., Electric Coating Div.—A new booklet describing Ransburg Electrostatic painting processes—spraying, dipping, etc. A chart showing a typical spraying assembly is included, together with installation data.

Worm Hob List

Brad Foote Gear Works — 12-page catalog section, Standard Worm Hob List, containing information on about 700 different hobs with necessary dimensions.

Allied Solenoid Valve

Allied Control Valve Co., Inc.—Bulletin on allied solenoid valves gives sectional drawings, mounting diagrams and detailed specifications.

Milling and Boring Machines

Kearney & Trecker Corp.—48-page general catalog, No. E-53, devotes six illustrated pages to a short history of the company and its products. The balance of the catalog gives a concise presentation of the company's entire line of milling machines, boring and milling machines and accessories and allied products. Specifications of all machines, including both English and metric descriptions are presented in line drawings and 2-color tables.

Otiscoloy

The Jones & Laughlin Steel Corp.—16-page, 2-color illustrated Otiscoloy booklet, giving technical information, suggested applications and other useful information on their new weight-saving J & L Steel.

HPM Turbojector

Hydraulic Press Mfg. Co.—Bulletin No. 4601 describes in detail the operating and production features of the HPM Turbojector, for the injection molding of mechanical rubber parts.

Industrial Research

Armour Research Foundation — 20-page booklet, Industrial Research Progress, describes the Foundation's activities in engine and lubricants research as well as in other major fields of chemistry, engineering, metallurgy and physics.

Safety Tools

Ampco Metal, Inc.—Catalog No. 117 covering Ampco safety tools, a price list is included together with specifications and information on more than 500 items.

Tool Grinding Fixture

The George Scheer Co.—4-page folder describing and illustrating its new tool grinding fixture. Illustrations show various tool grinding set-ups.

Chucking Machine

The National Acme Co.—12-page 2-color bulletin describing the Acme-Gridley single spindle Chuck-Matic, includes complete information concerning design and construction features, work capacities, methods of operation and size specifications. The bulletin illustrations tell the story of the Chuck-Matic and descriptions are in easy-to-understand terms.

Additional Dodge, De Soto and Chrysler Models Priced

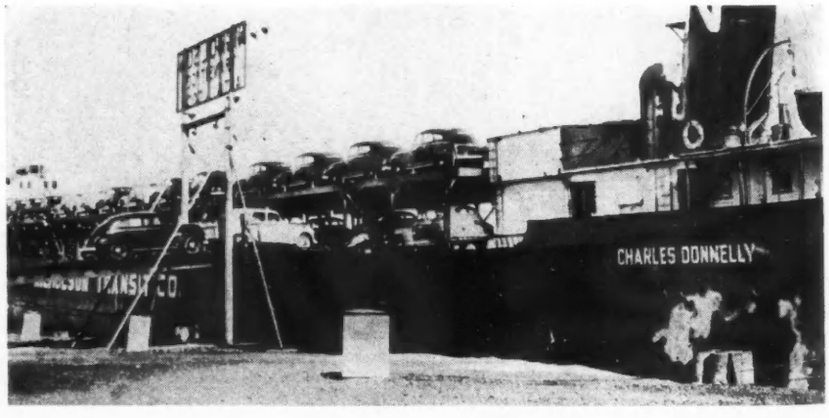
The Office of Price Administration has announced ceiling prices for nine additional models of passenger cars built by the Chrysler Corp. Included in the new prices are recent approved wage increases, and engineering and other improvements. These prices, F.O.B. factory, do not include excise taxes, transportation, or preparation and handling charges.

	1946 retail prices	1942 retail prices
Dodge		
Custom 7-pass. sedan.....	$1417	$1385
Limousine	1513	1465
De Soto		
Custom 7-pass. sedan.....	1569	1494
Limousine	1672	1570
Chrysler		
New Yorker 8-cyl. conv. coupe	1809	1629
Royal 7-pass. sedan	1636	1525
Royal limousine	1742	1595
Windsor 7-pass. sedan	1716	1595
Windsor limousine	1821	1675

Low-Priced Mercury Car To Be Announced in Canada

Ford Motor Co. of Canada, Ltd., plans to announce soon a new low-priced Mercury car. The company recently reorganized its distribution set-up into two principal divisions, one to handle Mercury and Lincoln products, the other for distribution of the Ford and Monarch lines. The new smaller Mercury will give Lincoln-Mercury dealers a low-priced car. Details have not been announced, but it is understood that the new car definitely will not be in the same category as the so-called light-weight, low priced cars, such as Ford and Chevrolet are contemplating.

Automobile Flattop



Said to be the only automobile flattop in the world, the steamer Charles Donnelly is loaded with new cars for delivery on the Great Lakes. This method of transportation for new cars from Detroit was originated by Nicholson Transit Co. Acme photo.

How To Eliminate Production Operations with Carpenter Alloy Steels

---------FOR LOWER COSTS ALL ALONG THE LINE---------

In your search for *lower manufacturing costs,* look into the cost-saving possibilities of cutting down the operations you perform on alloy steel parts.

For example, in buying an SAE Steel it pays to do more than check the analysis. Look into its "character", its adaptability to the job you have cut out for it. First check for the right combination of physical properties . . . hardness—toughness—wear resistance . . . whatever you need for the job. Then find out how the steel can help you cut unit costs.

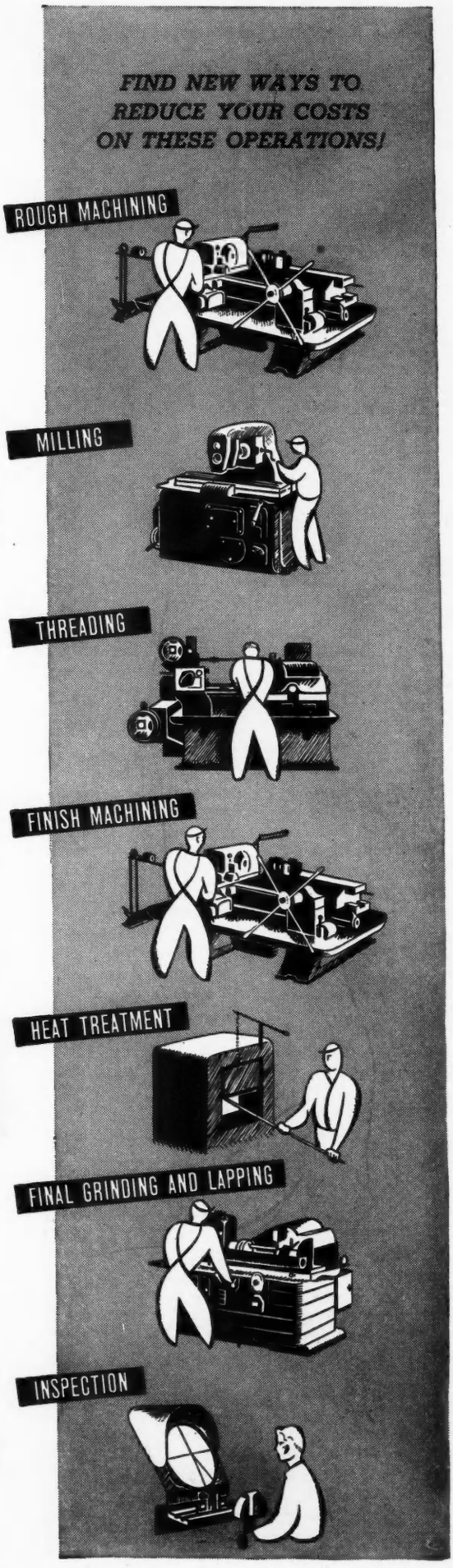
And here's the way to do it . . . right now.

Use a Carpenter Special Purpose Alloy Steel that is manufactured and inspected to tool steel standards. One manufacturer *reduced machining time and cut unit costs 78%* on one part . . . merely by using a Carpenter Special Purpose Alloy Steel that was tailored to *fit the job.* You can get similar results, by calling on Carpenter for help with your alloy steel problems.

Carpenter knows how to furnish alloy steels with a finish, or heat treatment, or close tolerance that is a step nearer to your finished product requirements. We can guarantee uniformity from lot to lot, to insure dependable product performance, reduce rejects, save production time and cut your unit costs. If you are interested in the cost-saving advantages of Carpenter Special Purpose Alloy Steels, just drop us a line. We will be glad to send you a copy of the new booklet, "Fitting the Steel to the Job." It contains more detailed information on what custom-made alloy steels can do for you.

Carpenter
SPECIAL PURPOSE
ALLOY STEELS

. . . made in a tool steel mill
. . . inspected by tool steel standards



THE CARPENTER STEEL COMPANY • 103 W. BERN STREET, READING, PA.

Stout Discloses His "Car of the Future"

William B. Stout, automotive and aircraft designer, has disclosed details of his newest vehicle, which he calls the "car of the future." Embodying the designer's ideas of possible future developments, the car has a body constructed of Fiberglas plastic, rear-engine drive, no chassis or axles, air springs, extra long wheelbase, and more interior room than any other car of comparable outside dimensions.

Called the "Stout Forty-Six," the new car is an outgrowth of the "Scarab," a vehicle of unconventional design which Stout built several years ago. The Fiberglas plastic is a material fabricated of glass fiber impregnated with a resin under high heat and pressure. Except for the doors, the entire body, including floor, roof, sides, and ends is molded in one piece. The interior of the body measures six ft wide and 11 ft long. The driver's seat is located a little left of center and is adjustable forward and back. A six-ft couch that can be made up into a Pullman style bed forms the rear seat. In addition there is room for two or more movable reclining type chairs. The interior is carpeted and luxuriously upholstered. The windshield is of curved design, with the corner posts moved back 12 in. for unobstructed vision. Special windshield wipers were designed for the curved surface by Trico Products Corp.

A special gasoline-operated heating unit, developed by Stewart-Warner, is mounted in the front baggage compartment and works independently of the engine, providing a flow of hot air which enters the interior through ducts on the car wall near the floor. It is regulated by a thermostat to provide heat, ventilation, and defrosting.

The car is mounted on individually sprung wheels located at the extreme ends of the car, eliminating overhang. Each wheel suspension is sprung on an air cushion which can be inflated to accommodate any particular load. Doors are opened with electric push-buttons eliminating door handles or other protruding obstructions. A bumper, of Fiberglas construction, is faired into the body and runs around the entire car. Overall weight of the present model is about 3200 lbs and wheelbase is 137 in.

The powerplant now being used is the same one employed in the Scarab, a Ford V-8 engine. However, a new 100-hp air-cooled engine soon will be substituted, together with an improved drive. It is understood that the engine is the new Jack & Heintz development with a total weight of about 300 lb, including transmission and differential and measuring only 12 in. high. Its use is expected to cut about 400 lb from the overall weight of the car. In addition, Mr. Stout estimates that further body construction refinements will reduce the weight another 600 lb.

There is as yet no indication that the car is intended for immediate manufacture. Rather it is said to represent what can be done in future design. Mr. Stout says that while the Fiberglas construction affords great strength and insulation against heat and noise. present manufacturing processes are too slow, and consequently too costly, to permit volume manufacture. He predicted, however, that within 18 months or so, a flash curing method could be worked out to overcome production troubles. He also pointed out that the design of the car is the important immediate consideration and that the body could be built of conventional materials.

Although the body was built by Owens-Corning-Fiberglas Corp. to Stout's specifications and construction was done at Graham-Paige, the car is announced as a Stout project. It is understood that patent rights owned by Stout, Graham-Paige, and Consolidated-Vultee Aircraft are involved. It is understood further that Graham-Paige holds certain manufacturing rights to the car, but not exclusively. At a press conference several weeks ago, Joseph W. Frazer, president of Graham-Paige and of Kaiser-Frazer, said that Kaiser-Frazer had no particular interest in the Stout rear-engine car.

PERSONALS

Recent Appointments Among Automotive and Aviation Manufacturers:

General Motors Corp., Detroit Diesel Engine Div., **E. J. vanDyk,** Petroleum Industry Field Engineer and District Manager of Sales.

Chevrolet Motor Div., **L. N. Mays,** Manager of National Business Management Dept.

Ford Motor Co., **Herman L. Moekle,** Vice-Pres. chg. of Finance; **John R. Davis,** Vice-Pres., Sales and Advertising; **John S. Bugas,** Vice-Pres., Industrial Relations and **Albert J. Browning,** Vice-Pres. in chg. of Purchasing. **L. E. Briggs,** Treas.; **H. E. Schluchter,** Secretary; **Fred A. Thomson,** Asst. Sec. and Asst. Treas.; **Gordon Cornwell,** Auditor. **W. S. James,** Director of Research, appointed to staff of Henry Ford II, responsible to the President for all research. **B. J. Craig,** Manager of Ford Motor non-profit enterprises. **W. A. Williams,** Ford Sales Mgr.

Pontiac Motor Division, **J. Hawley Otis,** reappointment as accessory sales manager.

Graham-Paige Motors Corp., **Paul W. Heasley,** elected Asst. Treasurer.

Consolidated Vultee Aircraft Corp., **G. T. Bovee,** Controller.

North American Aviation, Inc., **Walter A. Spivak,** Chief Project Engineer.

Lockheed Aircraft Corp., **P. K. Yost, Jr.,** Domestic Sales Manager; **B. C. Monesmith,** Asst. Factory Works Mgr.

The Glenn L. Martin Co., Plastics and Chemicals Div., **Harold M. Parsekian,** Director of Sales and Technical Service.

Douglas Aircraft Co., Santa Monica Plant, **A. C. Wallen,** Production Manager; **Fred W. Herman,** Chief Engineer, Long Beach Plant.

Fairchild Engine and Airplane Corp., Ranger Aircraft Engines Div., **George F. Chapline,** Asst. General Manager.

Luscombe Airplane Corp., **James P. Cunningham,** Vice-Pres. in chg. of Production.

Boeing Aircraft Co., **Clifford E. Roberts** assigned to assist **James P.**

(*Turn to page* 60, *please*)

CALENDAR

Conventions and Meetings

Associated Business Papers, Hot Springs, Va., Spring Meeting, May 22-25
Amer. Iron & Steel Institute, New York Mtg. May 23
Assoc. of Battery Manufacturers, Spring Mtg., Cleveland May 22-24
Golden Jubilee, Detroit May 29-June 9
Indianapolis Motor Speedway Race, Indianapolis May 30
Mid-America Exposition, Cleveland May 23-June 2
SAE Summer Meeting, French Lick, Ind. June 2-7
Amer. Soc. of Mechanical Eng.—Detroit June 17-20
Institute of the Aeronautical Sciences, Annual Summer Mtg., Los Angeles July 18-19
SAE Natl. West Coast Trans. and Maint. Meeting, Seattle Aug. 22-24
Natl. Aeronautic Assoc. of Canada, International Air Show, Toronto Aug. 30-Sept. 7
SAE Natl. Tractor Meeting, Milwaukee, Wis. Sept. 11-12
Instrument Society of America, 1st Natl. Show, Pittsburgh Sept. 16-20
SAE Natl. Transportation and Maintenance Meeting, Chicago Oct. 16-17
SAE Natl. Fuels & Lubricants Mtg., Tulsa Nov. 7-8
American Welding Society Annual Meeting, Atlantic City Nov. 17-22
Natl. Metal Congress and Exposition, Atlantic City Nov. 18-22
SAE Natl. Air Transport Engineering Mtg., Chicago Dec. 2-4
Automotive Service Industries Show, Atlantic City Dec. 9-14

Fords Resign as Officers of Ford Motor Co. of Canada

Henry Ford and Henry Ford II have resigned as chairman and vice-president of Ford Motor Co. of Canada, Inc., but have retained their positions as members of the board of directors. New chairman of the board is W. R. Campbell, president of the company for the past 17 years. Douglas B. Greig, former treasurer, has been elected president to succeed Campbell.

LETTERING

In designing die castings, keep in mind that lettering, numerals, trade marks, diagrams or instructions can be cast on the surfaces.

Raised, rather than debossed engraving should be specified, since it is less costly to cut a design *into* a die than to make a raised design *on* the die surface. If, however, the engraving cannot project above the surface of a casting, debossed engraving can be achieved by using raised engraving on a removable panel set into the die.

The electric meter adapter box shown here is an excellent example of the utilization of engraving on a zinc alloy die casting. A wiring diagram has been cast on the interior—and lettering on the exterior—of this casting. The two surfaces on which the raised engraving appears are parallel to the die parting and, therefore, the engraving does not interfere with ejection of the casting from the die.

Additional data on engraving will be found in our booklet "Designing For Die Casting." To insure that you will get the most from your die casting dollar, ask us—or your die casting source—for a copy of this booklet.

ZINC
FOR DIE CASTING ALLOYS

The New Jersey Zinc Company, 160 Front St., New York 7, N.Y.

The Research was done, the Alloys were developed, and most Die Castings are based on
HORSE HEAD SPECIAL (99.99+% Uniform Quality) ZINC

Machine Design Group to Hold Technical Session

The newly-formed Machine Design group of the American Society of Mechanical Engineers will hold its first technical session on the afternoon of June 17, during the semi-annual meeting of the Society in Detroit. All engineers interested—whether A.S.M.E. members or not—are cordially invited to attend. A nominal registration fee is required of nonmembers. Following is the program for the session: "Application of Tables for Helical Spring Design," H. F. Ross, United Shoe Machinery Corp., Beverly, Mass. "High-Speed Chain Developments," A. W. Meyer, Brown & Sharpe Mfg. Co., Providence, R. I. "Evaluating Self-Locking Nuts for Industrial Equipment," Wm. E. Horenburger, Elastic Stop Nut Co. of America, Union, N. J.

H. L. Keller, Buick Motor Division, General Motors Corp., is chairman.

Office Workers at Ford Vote Against Union

The United Office and Professional Workers union (CIO) was rebuffed in its attempt to organize office workers and time study personnel at the Ford branch plant in Chicago recently. Office workers turned down the proposal that the union be its bargaining agent by a vote of 70 to 30. The time study workers rejected the union unanimously.

GRIZZLY

REG. U. S. PAT. OFF.

ANSWERS YOUR BRAKE LINING QUERIES

"Which brake lining should I use?" If that's your problem, perhaps Grizzly's answers to a few questions asked by other engineering, production and purchasing men may help you decide.

Q. What is Grizzly's background? **A.** Grizzly has a sound background of 30 years experience in the manufacture of fine brake lining for both automotive and industrial fields.

Q. What about Grizzly production? **A.** Grizzly is one of the largest producers of molded brake lining and operates two large capacity plants employing the most modern mass production techniques.

Q. Can Grizzly handle individual brake lining problems? **A.** Yes, for these reasons: Grizzly is large, yet highly flexible and those factors plus constant research and alertness to new brake lining developments enable Grizzly to solve brake lining problems of widely divergent natures.

Q. What are the characteristics of Grizzly brake lining? **A.** Here are just a few Grizzly brake lining features: (1) It is an exclusive asbestos-friction compound, molded on a strong wire-grid back. (2) It maintains a constant high coefficient of friction throughout longer life. (3) It is precision machined for quick, easy installation. (4) It provides all around superior braking performance under all conditions of service.

GRIZZLY MANUFACTURING COMPANY

PAULDING, OHIO

PLANTS AT PAULDING AND BELL, CALIF.

Warehouse Stocks in Principal Cities

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE *and* AVIATION INDUSTRIES

Further recession of general business activity has been indicated. The *New York Times* index for the week ended April 20 stands at 125.9, as compared with 126.7 for the preceding week and 143.9 a year ago.

Sales of department stores, as reported by the Federal Reserve Board, for the week ended April 27 declined to a total equaling 232 per cent of the 1935-39 average, as compared with 290 in the week preceding Easter. Sales were 26 per cent above the corresponding distribution in 1945, as against a like advance of 51 per cent recorded for the week before. The aggregate in 1946 so far reported is 24 per cent greater than the comparable sum in 1945.

Electric power production during the week ended April 27 registered a moderate reduction. The output was 9.9 per cent below the comparable amount last year, as compared with a similar recession of 9.6 per cent reported for the preceding week.

Railway freight loadings during the week totaled 659,952 cars, 1.4 per cent more than in the week before but 26.7 per cent below the corresponding number a year ago.

Crude oil production in the week ended April 27 averaged 4,672,050 barrels daily, 14,250 barrels less than the average for the preceding week and 132,765 barrels below the comparable figure in 1945.

Bituminous coal and lignite production during the week ended April 20 was estimated at 710,000 tons, as compared with 650,000 tons in the week before and 11,234,000 tons a year ago. The output in 1946 so far reported is 10.7 per cent below the corresponding production in 1945.

Civil engineering construction volume reported for the week ended May 2 by *Engineering News-Record* is $108,809,000. This amount is 17 per cent below the figure for the preceding week but 432 per cent above that reported a year ago. The eighteen-week total recorded for 1946 is 190 per cent more than the comparable sum in 1945. The increase shown for private construction is 528 per cent, and the advance in public projects is 42 per cent.

The wholesale price index of the Bureau of Labor Statistics for the week ended April 27 is 109.5 per cent of the 1926 average, as compared with 109.6 for the preceding week and 105.7 a year ago.

Member bank reserves increased $290,000,000 during the week ended May 1. Underlying changes thus reflected include a rise of $183,000,000 in Reserve Bank credit and a gain of $24,000,000 in Treasury deposits with Federal Reserve banks, accompanied by an increase of $11,000,000 in money in circulation.

Total loans and investments of reporting member banks declined $175,000,000 during the week ended April 24. A reduction of $41,000,000 in commercial, industrial and agricultural loans was recorded. The sum of these business loans, $7,648,000,000, shows a net increase of $1,530,000,000 in twelve months.

N-A-X HIGH-TENSILE STEEL HAS ALL SIX—KEEPS ALL SIX

- HIGH STRENGTH
- EASY FORMABILITY
- EXCELLENT WELDABILITY
- HIGH FATIGUE-RESISTANCE
- GREAT IMPACT TOUGHNESS
- HIGH CORROSION-RESISTANCE

GREAT STEEL FROM GREAT LAKES

FOR LIGHTER WEIGHT . . . LONGER LIFE IN TRANSPORTATION EQUIPMENT

Combining great inherent strength with exceptional formability, N-A-X HIGH-TENSILE steel has wide application in the design of improved transportation equipment. Where reduced weight means increased efficiency, its high physical properties may be utilized to permit thinner sections; if greater durability is the important consideration, identical sections can be made stronger and tougher with N-A-X HIGH-TENSILE steel.

Consistent with the trend toward lighter, more efficient designs, N-A-X HIGH-TENSILE benefits the field of transportation by eliminating deadweight in favor of greater payloads.

GREAT LAKES STEEL CORPORATION

N-A-X ALLOY DIVISION • DETROIT 18, MICHIGAN
UNIT OF NATIONAL STEEL CORPORATION

German "Comet" Tested to Determine Potentialities

Tests have been initiated at Muroc Dry Lake to determine flight potentialities of the captured German "Comet" (Messerschmidt 163B). This glider-type craft was reputed to be one of the fastest and most successful tailless, rocket-powered interceptors used operationally by the Nazis in World War II.

Wing span of the "Comet" is 30.25 ft, length 19.5 ft, weight about 9,500 lb, fuel capacity 335 gal; best fuel used by Germans probably methanol hydrazine hydrate and potassium copper cyanide. Power unit weights only 220 lb. Unique feature of combustion chamber is the use of 17 mixing jets with selector lever for pilot to vary thrust at four stages. Landing gear can be jettisoned.

Body Engineers Form New Society

Announcement has been made of the formation of a new engineering society called "The American Society of Body Engineers, Incorporated," by its president, I. Louis Carron, body engineer of the Detroit Harvester Co. The society has been organized as a non-profit corporation with national headquarters in the Rackham Memorial Building in Detroit. This is an organization composed entirely of leading body engineers from practically all the companies in the automotive industry.

A Technical Convention will be held in October by the society, in the Rackham Memorial Building, with Mr. Carl W. Cenzer as general chairman. Plans already are well underway. Committees are being formed and are to be headed by capable and experienced men who have devoted many years toward the progress of body design and engineering.

THE basis of *thorough engineering* in Lamb Electric motors is an intimate knowledge of the operating conditions of the product.

The soundness of this approach to special motor design is evidenced by the reputation for dependability gained by Lamb Electric motors in both prewar and wartime operation.

THE LAMB ELECTRIC COMPANY • Kent, Ohio

Lamb Electric
FORMERLY Black & Decker Electric
SPECIAL APPLICATION FRACTIONAL HORSEPOWER **MOTORS**

Personals

(*Continued from page* 56)

Murray, Vice-Pres. in chg. of Washington office.

Beech Aircraft Corp., **Henry B. DeSpain,** appointed Service Manager.

The Electric Auto-Lite Co., **Royce G. Martin,** re-elected President and Chairman of the Board of Directors. Officers elected include **D. H. Kelly,** Executive Vice-Pres.; **W. V. Flood,** Vice-Pres. and Comptroller; **B. A. Fay, L. H. Middleton, D. B. Stratton, J. A. Minch, J. P. Falvey, J. R. Padesky, C. L. Patterson, C. W. Pound** and **T. W. Flood,** Vice-Presidents; **J. B. Fenner,** Treasurer; **F. J. Kennedy,** Secretary and **Russel McGee,** Asst. Secretary.

The Timken-Detroit Axle Co., **W. Robert Timken,** elected a Director—filling vacancy created by death of **Austin Lynch.**

International Nickel Co., Inc., Development and Research Div., **R. M. Wilson, Jr.,** Welding Engineer, Technical Service Section.

Stewart-Warner Corp., Alemite Distribution Div., **Charles I. Kraus,** Sales Manager and **Gustave Treffeisen,** Asst. Sales Manager.

Bendix Aviation Corp., **Marvin A. Heidt,** elected Vice-Pres. in chg. of Industrial Relations.

United States Rubber Co., U. S. Tires Div., **Cliff G. Currie,** Sales Engineer.

American Anode, Inc., affiliate of The B. F. Goodrich Co., **Burton F. Stauffer,** retired as President and General Mgr.

Allegheny Ludlum Steel Corp., **Frank B. Lounsberry,** elected to newly created office of Vice-President in Charge of Methods and Processes. Other new Vice-Presidents are **M. C. Harris,** Production; **E. J. Hanley,** Secretary and Treasurer and Finance and **Clark W. King.**

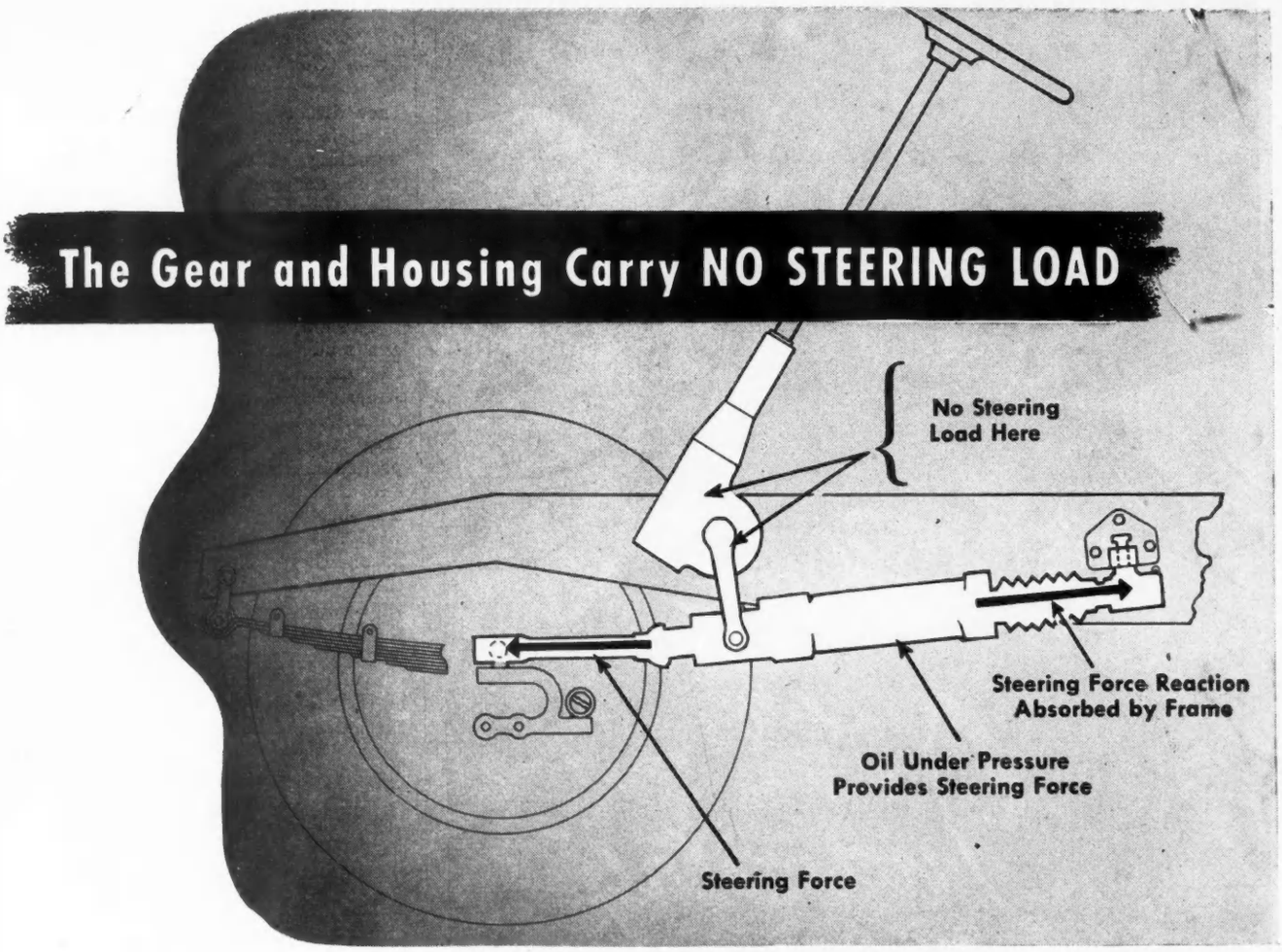
E. W. Bliss Co., **Marshall M. Smith,** Asst. General Sales Manager.

Lapointe Machine Tool Co., **Kenneth N. Macomber,** Chief Engineer.

Eaton Manufacturing Co., **Victor Matulaitis,** Sales Engineer, Heater Div.

Shuler Axle Co., **Richard C. Carson,** Sales Manager.

Optimus Equipment Co., **Walter R. Fidelius,** Asst. Chief Engineer.

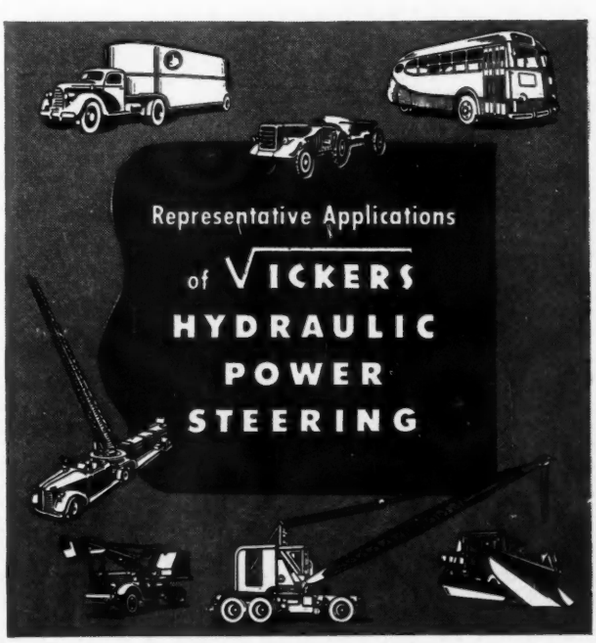

The Gear and Housing Carry NO STEERING LOAD
No Steering Load Here
Steering Force Reaction Absorbed by Frame
Oil Under Pressure Provides Steering Force
Steering Force

With VICKERS

HYDRAULIC POWER STEERING

Neither steering load nor road shock can reach the steering gear and housing when Vickers Hydraulic Power Steering is used. All the steering load is carried by the hydraulic cylinder, and road shocks are transmitted to the frame. The Vickers booster unit is controlled by the pitman arm and actuates the drag link directly. Direct application of power assures protection against wear or failure in the steering gear proper—makes it possible to use a lighter, more economical gear and housing with complete safety.

There are many other advantages of effortless Vickers Hydraulic Power Steering. Ask for Bulletin 44-30 which contains complete information.



VICKERS *Incorporated*

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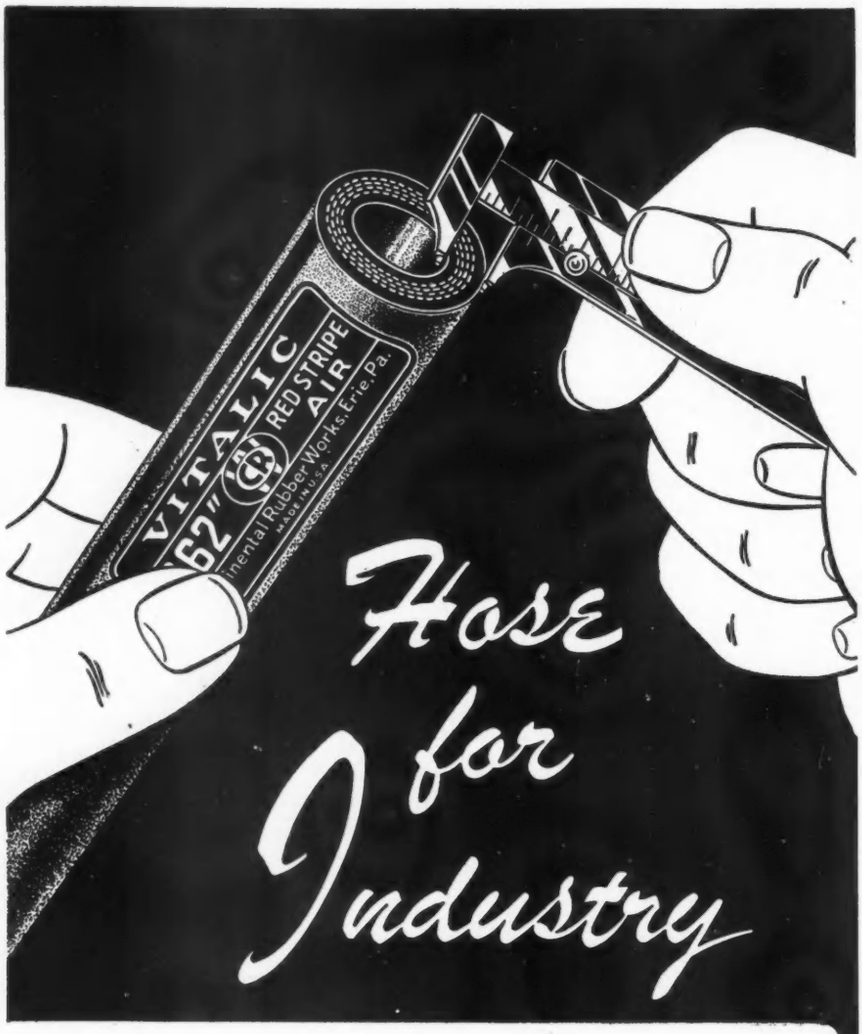
Application Engineering Offices: CHICAGO • CINCINNATI • CLEVELAND • DETROIT LOS ANGELES • NEWARK • PHILADELPHIA • ROCHESTER • ROCKFORD TULSA • WORCESTER



THE longer life you expect—and get—from Continental hose is the direct result of precision methods maintained in every step of the hose-building process. Remember that Continental are longtime specialists in hose design. It will pay you to check your hose requirements with your nearby Continental branch or write the factory direct.

BRANCHES

Baltimore, Md.	Dallas, Texas	Kansas City, Mo.	Philadelphia, Pa.
Boston, Mass.	Dayton, Ohio	Los Angeles, Cal.	Pittsburgh, Pa.
Buffalo, N. Y.	Detroit, Mich.	Lutz, Fla.	Rochester, N. Y.
Chicago, Ill.	Greensboro, N. C.	Memphis, Tenn.	St. Louis, Mo.
Cincinnati, Ohio	Hartford, Conn.	Milwaukee, Wis.	San Francisco, Cal.
Cleveland, Ohio	Indianapolis, Ind.	New York, N. Y.	Syracuse, N. Y.

★ *Continental also manufactures molded, extruded and lathe cut goods, as well as a complete line of packing and other industrial maintenance items.*

SEE OUR CATALOG IN SWEET'S

CONTINENTAL RUBBER WORKS

ERIE • PENNSYLVANIA • U. S. A.

News of the Industry

(*Continued from page* 52)

ther discord. Another disturbing element is that there already are further rumblings about additional wage increase demands soon to compensate for the rising cost of living.

Export Market for Cars Lies South of Border

The major export market for American made automotive products lies in the expanding market in the Latin-American countries, in the opinion of C. B. Thomas, president of Chrysler Export Corp. He says that good roads programs are being carried on there and that the demand for automotive transportation will increase progressively. Because there is no significant automotive manufacturing south of the Rio Grande, American companies are expecting to do a large export business there. Mr. Thomas said that Europe has made a remarkable recovery since the end of the war. He predicted a market for at least 100,000 cars a year there for the next five years.

Effect of Studebaker Introduction On Industry Still Uncertain

Since Studebaker announced its 1947 models, considerable comment has been floating around Detroit about its effect on other manufacturers, who have indicated they will delay changeover until at least the end of this year. The new Studebaker is of radically different design and is the first car of any established manufacturer to incorporate the advanced styling expected of a new model. So far, there is no discernible concern on the part of any company about the competitive influence the new car may have in the field. One spokesman says that as long as his company can sell all the cars it can produce, it will not deviate from its original course of holding off new models until next year. He admits, however, that of the public acceptance of the new Studebaker should cause buyers to hold back buying current models, the changeover might be set ahead of the original date by a few months. The general idea, however, is to await developments. Most companies consider it economically unwise for them to undergo a change of model right now because production has not been in sufficient volume to warrant obsoleting dies and other equipment. They say that competition will be the major force which might force a changeover before the end of this year.

Advertising Note

J. Walter Thompson agency has been appointed to handle domestic advertising and Dorland International-Pettingell & Fenton will handle foreign advertising of the Douglas Aircraft Co.

Why clinch, stake or weld ?

Just snap in a latching SPEED NUT

A PRESS OF THE THUMB SNAPS LATCHING TYPE SPEED NUT SECURELY IN PLACE
SPEED NUTS eliminate handling of material
DON GOOTTON

A SPEED NUT CASE HISTORY

A motor truck manufacturer used a battery of machines to clinch nuts in place for assembly of dash to cowl and attachment of instruments and equipment to dash. Two men were required to operate each machine . . . to handle the large stampings and position them for attachment of the fasteners. This extra handling meant frequent damage to stampings, and then after painting, nut threads had to be re-tapped.

30 self-retaining Speed Nuts are now snapped in place by hand on each stamping as it moves from the press department on conveyers. The entire assembly is completed in much less time, machines eliminated and costs substantially reduced.

Sure, there are a lot of ways to attach nuts to mid-sections of panels for blind location assembly, ***but*** they require expensive equipment, valuable floor space and skilled operators. Panels must be taken off conveyer, carried to press or welder and carefully positioned to attach the fasteners.

Now with Latching type Speed Nuts, panels stay right on the conveyer, and the assembler merely snaps the Speed Nuts in place by hand. These Speed Nuts are ***self-retaining,*** holding themselves firmly in place until the screw is driven from opposite side. Moreover, Speed Nuts provide a spring tension lock that holds tight under the most severe vibration.

We've developed many types of self-retaining Speed Nuts to simplify and reduce the cost of blind location fastening. We'll be glad to show you how they can improve the assembly of your product. Send in your details today!

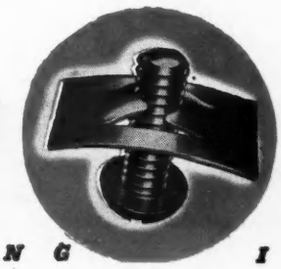
TINNERMAN PRODUCTS, INC.

2059 FULTON ROAD • CLEVELAND 13, OHIO

In Canada: Wallace Barnes Co., Ltd., Hamilton, Ontario
In England: Simmonds Aerocessories, Ltd., London
In France: Aerocessoires Simmonds, S.A., Paris
In Australia: Simmonds Aerocessories, Pty. Ltd., Melbourne

Speed Nuts*

MORE THAN 3000 PATENTED SHAPES AND SIZES



* Trade Mark Reg. U. S. Pat. Off.

FASTEST THING IN FASTENINGS

Pressure Welded Joints

(*Continued from page* 36)

upsets were required. In this case, however, longitudinal oscillation was begun at the start of upset.

Pressure welds can be made without longitudinal oscillation of the burner; this depends on the size and thickness of the parts. However, in the present tests longitudinal oscillation was used to advantage to help control the heat gradient through the tube wall, and to prevent excessive external melting.

Beveled Joints

Another method used to induce more uniform heating through the tube wall was beveling of the tube ends. Both external and internal bevels were tried. The external bevel produced the desired results insofar as faster and more uniform heating of the tubes was concerned. Also, the volume of external upset was reduced because the external bevel tended to direct initial upset inward. However, the reduction in wall thickness at the joint led to extreme outbent fiber at final upset. It was felt that this was detrimental to the strength of the joint in bending, because the direction of tensile stress was essentially normal to the flow lines. It was noticed that some of the bend failures in this series started along the outbent fiber rather than on the weld line.

The internal bevel, used in conjunction with protective gases, produced some of the best welds made (Schedules M and N). A possible additional benefit was that with the small bevel involved (2 degrees), the outbent fiber was not so extreme as with the wide external bevel.

Upset Distance

It is believed that oxidation of the weld surfaces can take place during the heating cycle even if the joint is machined square to insure good contact between the parts. Such oxidation, even if very slight, undoubtedly has a deleterious effect on the quality of the weld joint. Considerable work was done in an effort to eliminate or decrease the oxidation by various methods (fluxes, metal plating, and inert and reducing gases).

However, it was felt that the effects of oxide films could also be reduced by mechanically disrupting their continuity. This was done by increasing the upset distance. A comparison of Schedules D and J shows the improved strength obtained by increasing the upset distance. Both schedules were identical except that in Schedule D (average modulus of rupture, 144,000 psi), the upset distance was ¼ in., and in Schedule J (average modulus of rupture, 216,000 psi) it was ½ in.

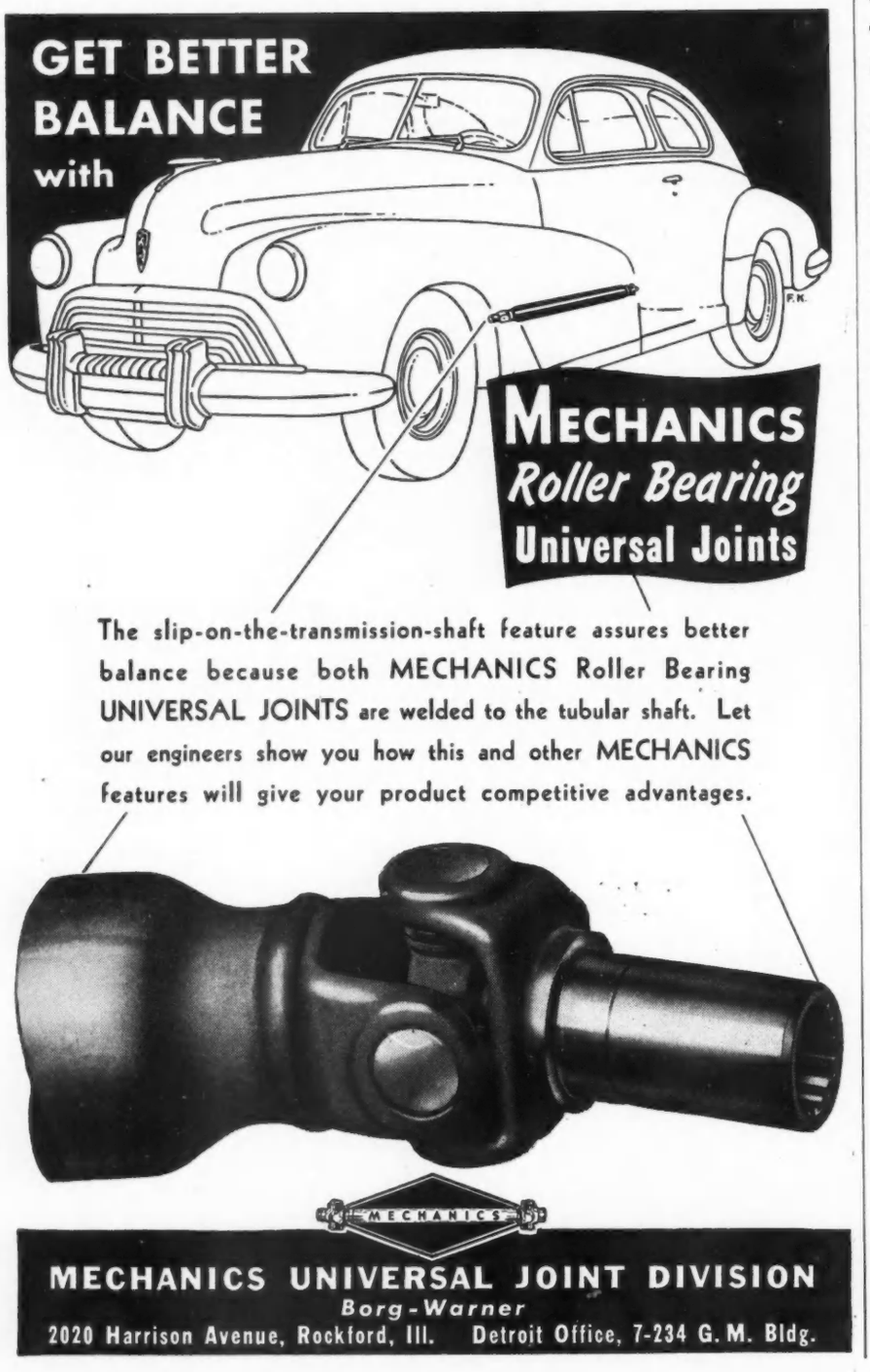
The beneficial effect of greater upset is also shown in Schedules C and K, bevel joint welds. These were also identical, except that in Schedule C (average modulus of rupture, 137,000 psi) the upset distance was ⅜ in., and in Schedule K (average modulus of rupture, 217,000 psi) it was ½ in.

Protective Coatings and Gases

Bend tests of pressure welds made in air indicated that increasing the upset distance improved the weld strength. This may possibly have been caused by the disruption of the oxidized layer on the weld line. However, in every case metallographic examination showed that some weld-line oxidation persisted. Various methods were tried to actually protect the faces to be welded during the heating operation, by means of metallic and nonmetallic coatings and oxygen-free atmospheres.

The first protective medium tried was a thin film of nickel plate on both faces to be welded. The idea was that the nickel might afford adequate pro-

(*Turn to page* 66, *please*)


GET BETTER
BALANCE
with
MECHANICS
Roller Bearing
Universal Joints
The slip-on-the-transmission-shaft feature assures better balance because both MECHANICS Roller Bearing UNIVERSAL JOINTS are welded to the tubular shaft. Let our engineers show you how this and other MECHANICS features will give your product competitive advantages.
MECHANICS
MECHANICS UNIVERSAL JOINT DIVISION
Borg-Warner
2020 Harrison Avenue, Rockford, Ill. Detroit Office, 7-234 G. M. Bldg.

1

"Perfect" Oil Seals are steel encased, self-contained unit shaft sealing devices equipped with flexible Spring-loaded Sirvis Leather or Sirvene Synthetic Rubber packing members, applicable to all types of mechanical equipment.

Cost is negligible.

2

Retain lubricant (oil or grease) within the mechanism where it belongs.

3

Exclude moisture and foreign matter from the mechanism.

4

Prolong bearing life, reduce bearing maintenance, remove safety hazard and save both power and lubricant.

5

Applicable to anti-friction and sleeve bearings, vertical or horizontal, rotating or reciprocating shafts, within or protruding from a mecha

6

Compact, rigid and self-contained—require little space and are easy to install and replace.

7

Self-adjusting—no take-up or maintenance necessary and therefore ideal for inaccessible locations.

8

Flexible spring-loaded wiping lip hugs the shaft even though it be slightly out of alignment.

9

Minimum skin friction —designed for long trouble-free service life.

10

No wick action to draw lubricant away from bearing.

11

Packing member secured against rotation with the shaft.

12

Suitable for use with all standard lubricants.

13

Every part of seal assembly manufactured by Chicago Rawhide under close and rigid control.

14

Can be furnished resistant to oils, greases, water, acid and alkali attack.

Chicago Rawhide engineers are the pioneers in shaft sealing practice. Consult them on your sealing problems.

CHICAGO RAWHIDE MANUFACTURING COMPANY

1310 ELSTON AVENUE • CHICAGO 22, ILLINOIS

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66 YEARS MANUFACTURING QUALITY MECHANICAL LEATHER GOODS EXCLUSIVELY AND NOW SIRVENE SYNTHETIC PRODUCTS

tection to the steel during the initial heating period (without itself oxidizing), and would subsequently diffuse into the steel during upset and the final heating period. However, all of these weld joints were relatively weak. Failure occurred between the two nickel layers, and metallographic inspection of the weld sections showed that no appreciable diffusion of nickel into the steel had taken place.

One chromium-plated joint was tried, without success. Several kinds of flux coatings were also used, but the welds were poor because a thin layer of flux was always trapped at the plane of the weld.

Coatings of waxes and lacquers were also investigated with the thought that the faces to be welded would be protected from oxygen during the greater portion of the heating period, and that as the welding temperature was approached the coatings would volatilize, thus leaving no material to be trapped at the weld interface. The indications were that the coatings did volatilize, but either they volatilized too soon, or gave up oxygen of their own; metallographic inspection revealed considerable weld-line oxidation.

Since protective atmospheres have been used successfully in flash-welding to improve weld quality, the technique was also tried for pressure welding. Helium, hydrogen, and oxygen were used in these experiments.

After the tubes had been clamped in position in the welding machine, the gas was blown through the tubes to remove the air, and then, during heating, the gas was maintained in the tube at a low pressure, sufficient to force the gas past the welding faces as long as an opening existed.

The first welds were made with the gases taken directly from the cylinders. Metallographic examination of the joints revealed oxides on the weld line, and it was suspected that the gases may have contained slight amounts of moisture. Therefore, all subsequent tests were made with the gas dried, either by passing it through a calcium chloride drying tower or through a freezing tube and magnesium perchlorate. This seemed to improve the protective action of the gas.

Results of the later tests (Schedules E, F, G, H, L, M, N, and O) indicated that helium and hydrogen were quite effective in improving weld quality. Hydrogen was only slightly more effective than helium; this suggests that its function, like that of helium, was in excluding air from the joint, and that little reduction of oxides took place.

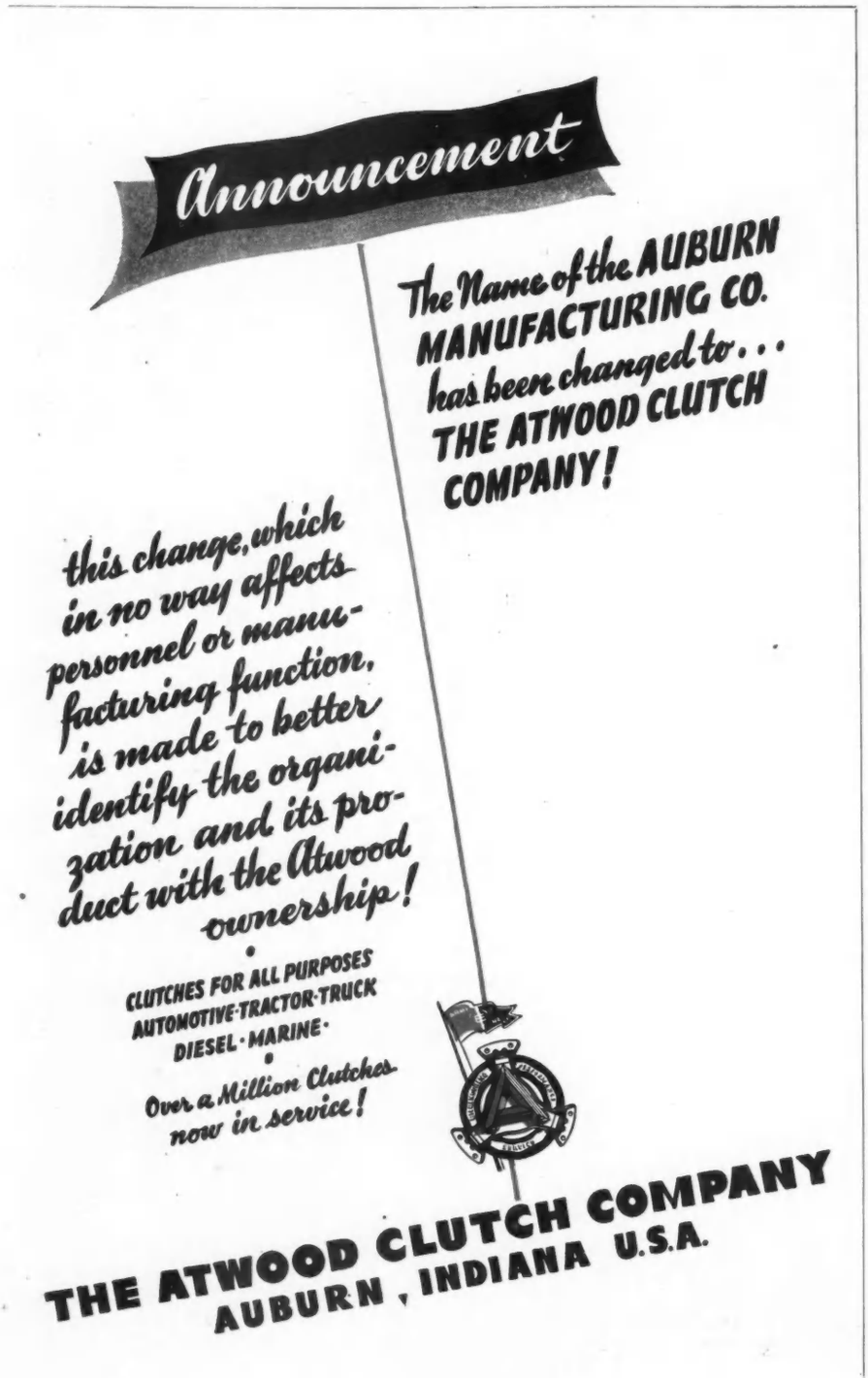
The use of protective atmospheres of dried helium or hydrogen was the most effective method of improving weld quality developed during the investigation. However, the gases did not completely eliminate weld-line oxidation, and the strength of the joints was not uniform. For example, the highest average modulus of rupture, 284,000 psi, was obtained with Schedule O, but the individual values ranged from 212,000 to 322,000 psi.

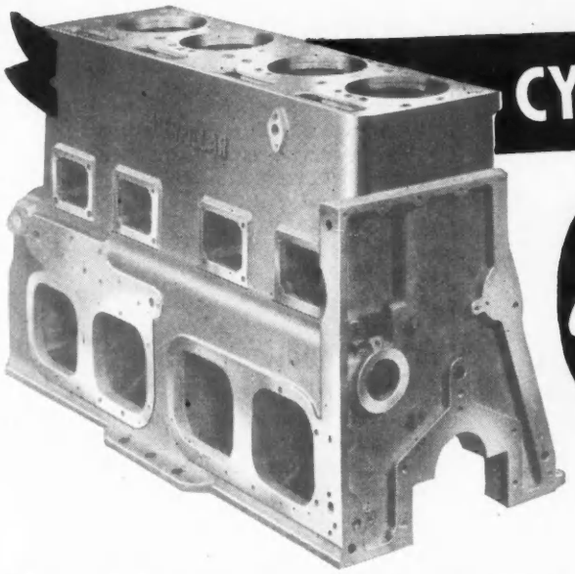
Heat Treatment After Welding

These tests indicated that while heat treatment after welding might improve the quality of the joint (by eliminating the original heat effects, promoting microstructural coalescence across the weld line, and diffusing carbon toward the weld line if decarburization had occurred during welding), it did not increase the strength of the weld so that the joint was always as strong as the parent tubes. Failures on the weld line, at less than 100 per cent efficiency (machined tubes), were encountered in almost all series of heat-treated welds.

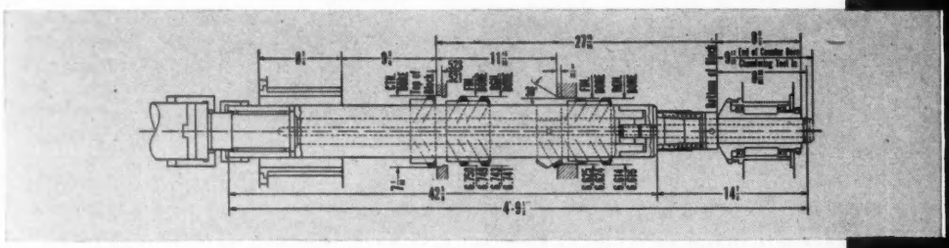
Metallographic inspection showed that the white band along the weld line, brought out by special etching techniques and believed to be indicative of oxygen in solution in the metal, was present even after heat treatment.

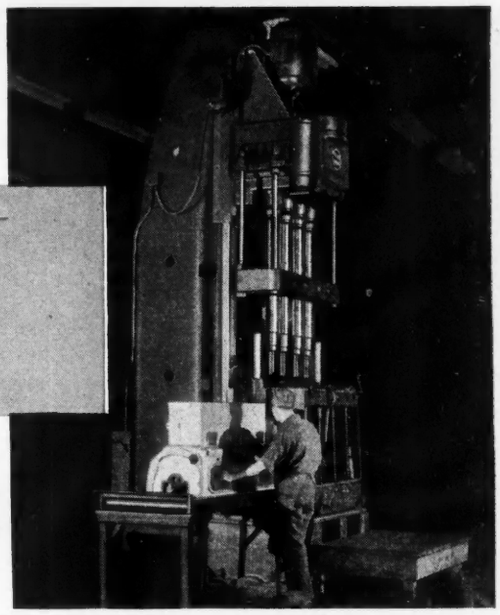
The foregoing article consists of extracts from research report No. W-215, "Evaluation of the Quality of Pressure Welded Joints in Alloy Steels, and of the Ease of Production Control of the Process," from the Office of Production Research and Development, Civilian Production Administration. The test work was conducted at Battelle Memorial Institute at Columbus, Ohio.


Announcement
The Name of the AUBURN MANUFACTURING CO. has been changed to . . . THE ATWOOD CLUTCH COMPANY!
this change, which in no way affects personnel or manufacturing function, is made to better identify the organization and its product with the Atwood ownership!
CLUTCHES FOR ALL PURPOSES
AUTOMOTIVE-TRACTOR-TRUCK
DIESEL-MARINE
Over a Million Clutches now in service!
THE ATWOOD CLUTCH COMPANY
AUBURN, INDIANA U.S.A.



CYLINDER BORING TIME Cut 15 Minutes





BORES HELD TO SIZE . . . CENTER LINES CORRECT . . . BORES SQUARE WITH FACES . . . WHEN MACHINED ON W. F. and JOHN BARNES No. 924 VERTICAL MACHINE

Cylinder liner holes in cast iron 4-cylinder diesel engine blocks are rough and finished bored, counterbored and chamfered on this W. F. and John Barnes No. 924 Vertical Machine, equipped with a heavy duty four-spindle boring head.

Machining time on the Barnes machine is 15 minutes, floor-to-floor; previous production time for these operations required 30 minutes on another machine. Bores are held to size and center lines correct, and bores are square with faces. Tolerances on finish boring are held to .001". The Barnes No. 924 Vertical Machine consistently produces the required accuracy and an extra fine bore finish.

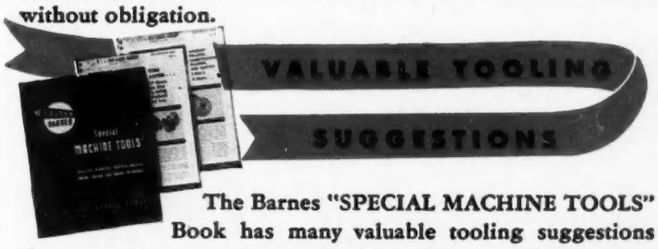
The cylinder block is progressed through a unit-type fixture, and a manually operated stop is provided for rough location of the block when loading. The heavy duty four-spindle boring head with 60" stroke has four special feed out type chamfering and boring bars; and operates in a cycle of rapid approach, first feed, second feed, dwell, rapid return, and stop.

GET SPECIAL PRODUCTION MACHINING WITH THIS STANDARD UNIT

The W. F. and John Barnes No. 924 Vertical is a versatile standard machine of unit type construction. It is designed for flexibility in *drilling, reaming, boring, chamfering, milling, hollow milling* and *facing* operations. Only changes in tool and fixture design are necessary to adapt this machine to a wide range of production jobs. It is highly suitable for mass production operations and especially on jobs requiring wide-area heads. Unusually slow feeds for heavy facing work are obtained by simple adjustment on the hydraulic unit mounted on the side of the column.

Where jobs require up to 60 h.p. and 50,000 lb. thrust, the Barnes No. 924 Vertical Machine is a profitable investment. Changes in machining sequences or in the design of parts do not obsolete this machine since the basic assembly can easily be adapted to other types of work.

Barnes engineers can show you how you can adapt the No. 924 Vertical to your specific work requirements . . . or assist in the design of other Barnes Special Machine Tools for other standard or special metal working operations. This service is without obligation.

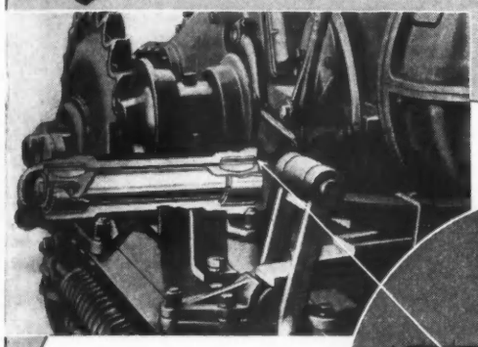


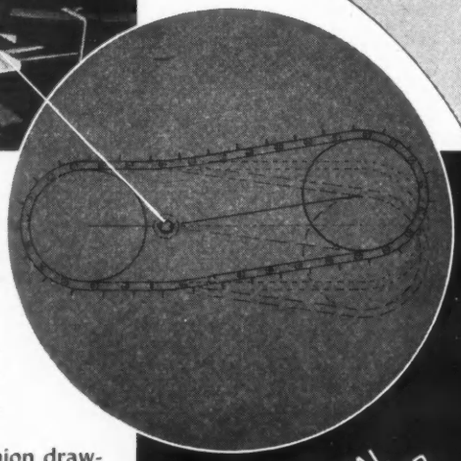
The Barnes "SPECIAL MACHINE TOOLS" Book has many valuable tooling suggestions that may increase your production efficiency. Performance stories covering various metal working operations in many fields are described in detail. Write for your copy today . . . on company letterhead. Ask for book No. 546.

W. F. and JOHN BARNES

312 SOUTH WATER STREET • ROCKFORD, ILLINOIS, U.S.A.

Torflex FLEXIBLE BEARINGS

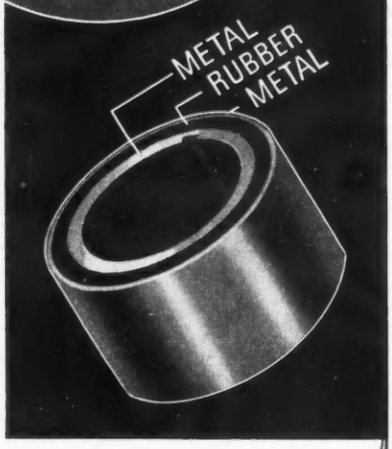




Torflex Bearings are designed to cover a wide range of applications in every field of industry.

For instance in the tractor field *Torflex* Bearings are used on the pivot axle shaft to accommodate oscillations of the bogie truck and cushion drawbar pull. Illustration shows *Torflex* Bearings in track shoe pins, where they eliminate wear, shock and vibration thereby prolonging the life of the equipment. Once installed they require no care, no lubrication and work efficiently and dependably for years. The adaptability and versatility of *Torflex* Bearings account for their wide acceptance by industry.

Torflex Bearings are used on all types of machinery, can be made in practically any size, are low in cost, simple and readily incorporated in new or existing equipment.



Send in for more detailed information.

HARRIS PRODUCTS CO.

5101 COWAN AVENUE

CLEVELAND 4, OHIO

★

New Products

(*Continued from page* 50)

tion of the feed rod ceases, bearing cools down and flow of oil stops.

The reservoir is of heavy walled unbreakable Lucite, eliminating hazards of broken glass. This Lucite will remain clear as glass and will not become cloudy with age or when exposed to sunlight.

Eastman Industrial Photographic Papers

Three new industrial photographic papers which are said to speed the production of paper positives from engineering drawings and to enable extra-high quality blueprints to be produced, have just been brought out by the Eastman Kodak Company.

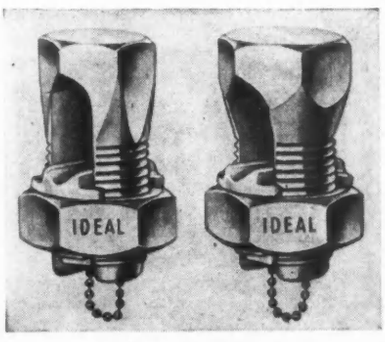
Known as Reflex Copy TXA, Linagraph Ortho TXA, and Linagraph Blue Sensitive TXA, the new papers are translucent, extra light weight, and have a high wet and dry strength. As a result, they can be used for filling purposes, or for binding into a book of drawings or printed matter.

Because of their extra light weight base, and high degree of translucence, these papers may be used in place of film negatives where rapid printing time in making subsequent positives is necessary. They can also be used in any branch of industrial copy work where prints of minimum weight and thickness are important.

Ideal Connectors

To supplement its line of wire connectors and lugs, Ideal Industries, Inc., 1014 Park Ave., Sycamore, Ill., has added split bolt connectors and service entrance connectors. The split bolt connectors are available in two types, "one piece" and "two piece," with small and large heads. They are also available either in bronze, brass, or aluminum. Uniform contact surfaces are said to assure maximum conductivity and low resistance. A wide range of sizes accommodate all solid and stranded wire from No. 6 to 1,000,000 CM.

The service entrance connectors are made from cold drawn copper with the screws made from Everdur. There are five sizes from No. 12 solid or No. 10 stranded to No. 2 stranded.



Ideal connectors

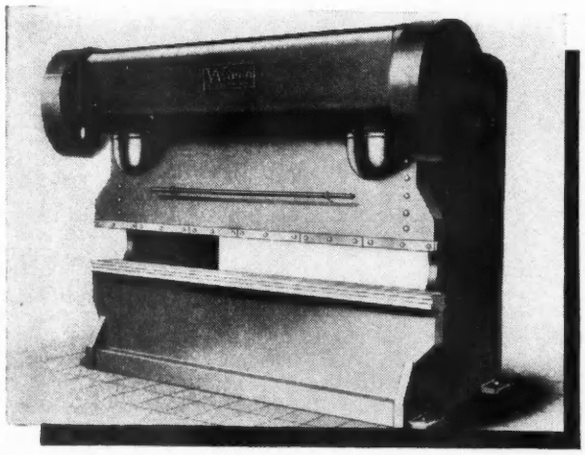
A Complete Line of

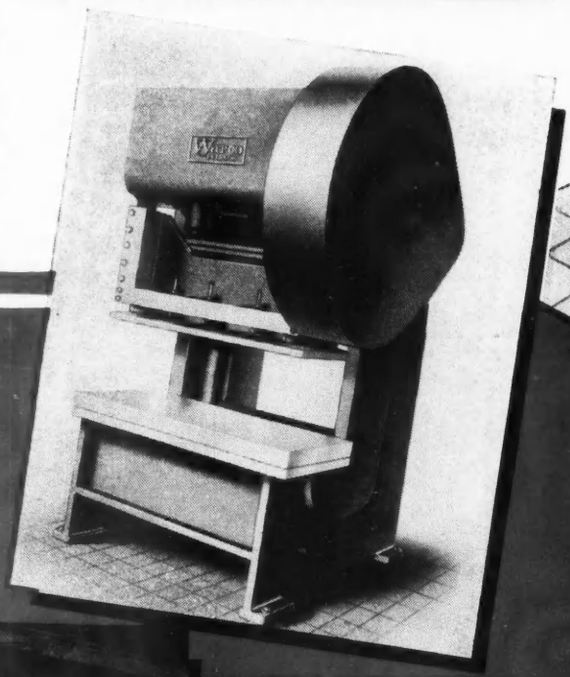
ALL-STEEL WELDED

★ Open Back Inclinable Models
★ Two-Point Eccentric-Gear Models
★ *Straight-Sided Hydraulic Models*
★ Mechanical Press Brakes

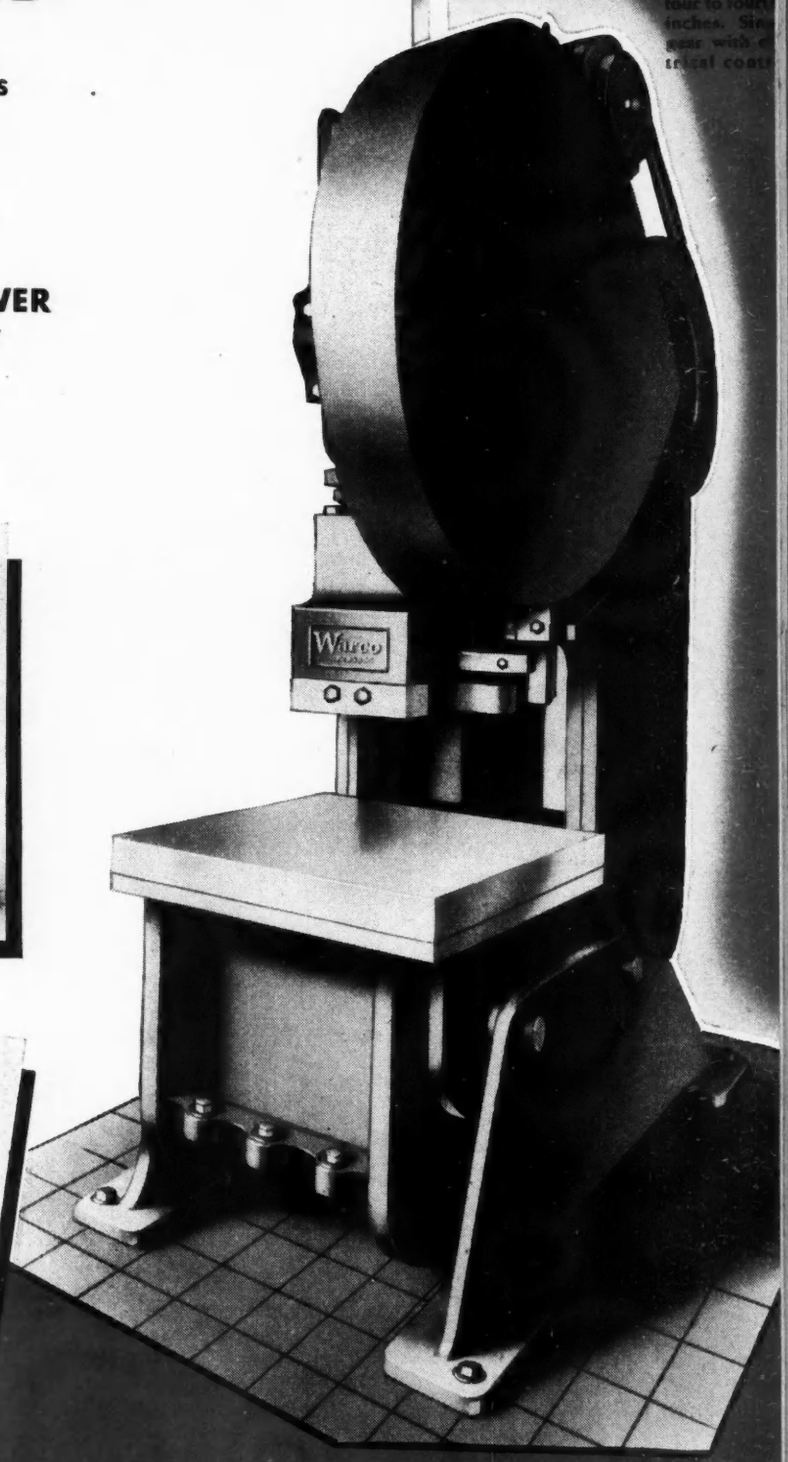
All weldments are *fully stress-relieved* to provide maximum

★ RIGIDITY ★ STRENGTH ★ POWER
★ ENDURANCE ★ ACCURACY



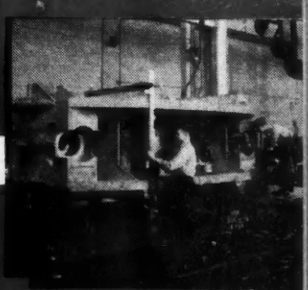


Above, press brake, capacity range, 100 to 500 tons, to handle lengths up to 24 feet and longer. Right, double-crank gap press, capacity range, 100 to 500 tons.



POLICY ON DELIVERIES

Unusually large production facilities lessen the delivery problem with us. We are in position to give prompt attention to your order or inquiry. For information as to the delivery of the press you need, we invite you to consult us today.



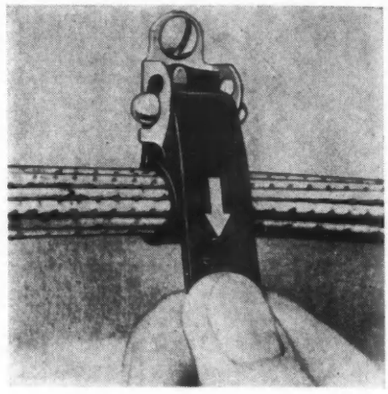
New Products for Aircraft

(*Continued from page* 46)

into the assembly, force the stator disc and back thrust plate apart permitting a free, rotating lining disc without drag.

Two New Tinnerman Products

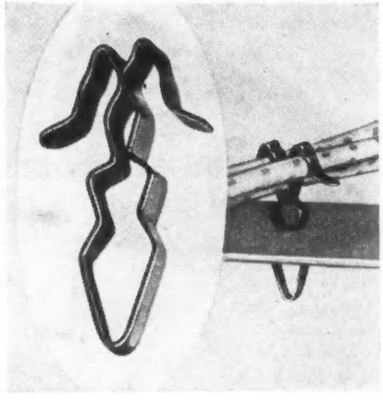
Tinnerman Products, Inc., 2059 Fulton Rd., Cleveland 13, Ohio, has brought out two new products. The first is a strap type harness clamp for aircraft that has been developed with greater flexibility of application. It can handle a wide variation in the group diameters of the wiring bundles. In fastenng this clamp, the strap is looped around the bundles of wires and then slipped under the loose-locking roller in the bracket. The strap is then pulled up tight and, with a sharp tug in the opposite direction, the roller is forced into locked position. To release, the heads of the roller are pressed to snap it to the free position. The strap itself is made of



Tinnerman harness clamp

Neoprene coated fabric to withstand minus 65 F to 160 F, and is fungus resistant. A glass cloth Neoprene strap may be provided to withstand still higher heat. The metal part is made of SAE 1020 steel, cadmium plated.

The other new Tinnerman product is a spring steel speed clip to simplify the assembly of wiring in aircraft and other products holding two or three parallel wires. This clip is snapped into a ⅛-in. round hole. It locks itself in place ready to receive the wires.



Tinnerman speed clip A3493-1

Assembly is then accomplished by pushing the wires into the clip where they do not contact each other. No tools are required. Fits in panels from .025 to .064 in. thick. Damaged wires can be replaced instantly without tools. It holds three No. 16, No. 18, or No. 20 insulated wires. The new clip is designated as speed clip A3493-1.

Special Form of Lucite Protects Fliers from Sun

A special ultraviolet-absorbing type of "Lucite" acrylic resin that will give protection from sunburn to fliers has been brought out by E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.

This new type of "Lucite" plastic sheeting, developed by du Pont for use on war planes, has already been speci-

(*Turn to page* 74, *please*)

- Buell Air Horns are tops in warning signal efficiency.
- Installed as original equipment on many Trucks and Buses.
- They reduce maintenance costs by decreasing stops, starts and slowdowns.
- All records prove that they save tires, brakes, clutches and gears.
- Cut gas and oil consumption.

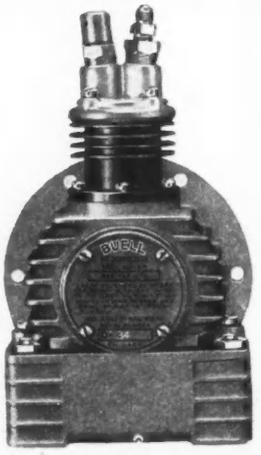
With a Buell the driver has greater security, maintaining a steady cruising speed. Slowing a 20 ton load from 50 MPH to 30 MPH means destroying a lot of energy thru brake lining and tires. It is replaced by burning more gasoline, increasing load on engine, and tires again, to regain speed. This all costs money. We believe a Buell Air Horn is worth $100.00 yearly on any heavy highway vehicle. Then remember a Buell will last more than 10 years. How would you rate a $100,000 investment that earned $100.00 yearly for 10 years. Ask the man who has a Buell

BUELL AIR COMPRESSOR

- Used on Passenger Cars, Trucks, Buses, Boats and Planes.
- Small and compact in size . . . efficient and powerful in action.

Buell engine-driven compressors supplied air to operate air brakes in thousands of R.C.A.F. aircraft. Only a combination of quality and precision workmanship could meet the requirements of this type of service.

Designed for compactness and light weight, they are far more efficient and powerful than their size indicates. Let us prove their adaptability to your needs.



BUELL MANUFACTURING CO.
2975 Cottage Grove Ave., Chicago 16, Ill.

YOU CAN SHAVE A GEAR A LOT FASTER than you can grind it

Gears requiring 40 minutes (floor to floor) for grinding are being shaved in just 5 minutes.

The shaved gears are just as accurate dimensionally as the ground gears; tooth surfaces are just as smooth and of equal if not greater importance, the shaved gear teeth are entirely free of those prevalent hairline grinding cracks which so often result in fatigue failures. Thus by shaving you get better gears faster and at less production cost.

Gears are shaved on Red Ring Rotary Shaving Machines which produce smooth tooth surfaces and correct errors of helical angle, profile and eccentricity. Gears from 3/16" to 220" P. D. can be shaved. Those from 3/8" to 36" P. D. can also be crowned to avoid the danger of failure due to "End Bearing."

NATIONAL BROACH AND MACHINE CO.

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SPECIALISTS ON SPUR AND HELICAL INVOLUTE GEAR PRACTICE

ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORMS

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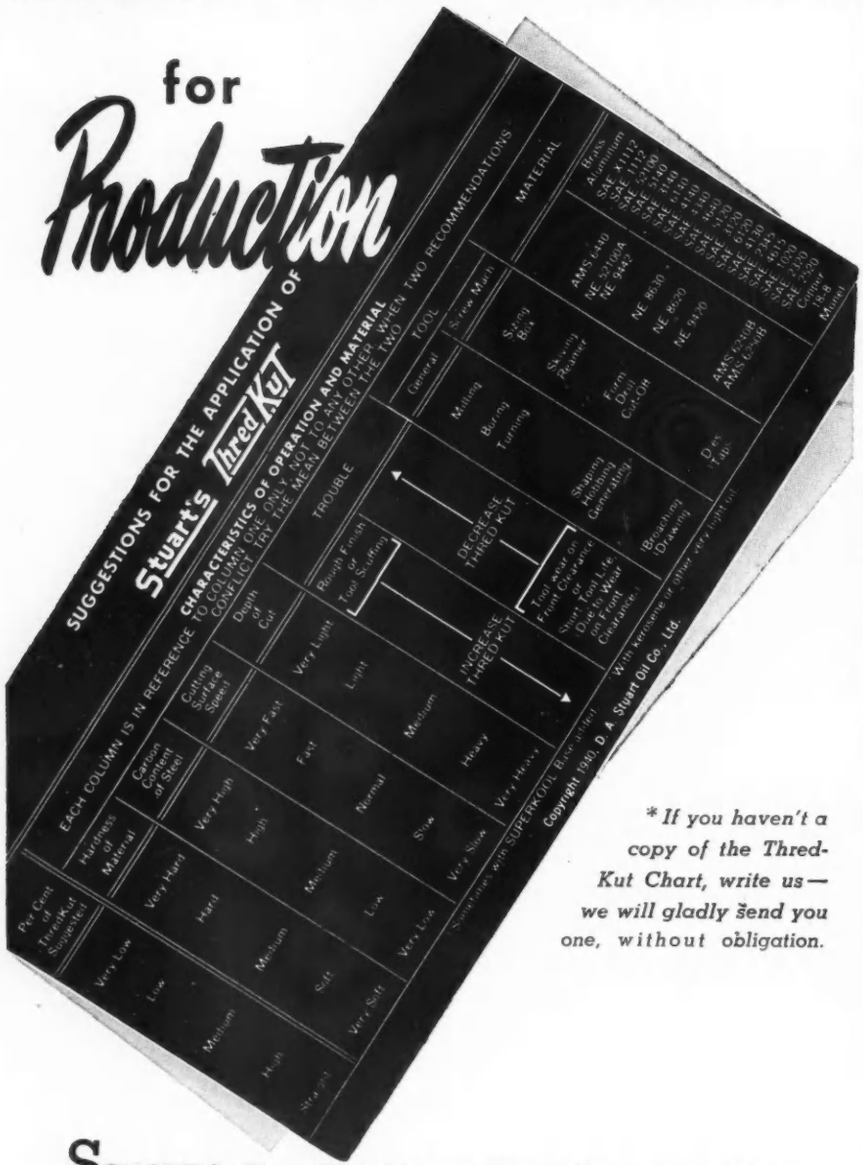
SUGGESTIONS FOR THE APPLICATION OF
Stuart's ThredKut
CHARACTERISTICS OF OPERATION AND MATERIAL
EACH COLUMN IS IN REFERENCE TO COLUMN ONE ONLY, NOT TO ANY OTHER WHEN TWO RECOMMENDATIONS CONFLICT TRY THE MEAN BETWEEN THE TWO
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DECREASE THRED KUT
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STUART'S ThredKut Heavy Duty Cutting Oil has played an important part in solving many of industry's toughest metal working problems. Reference to the time-tested ThredKut Chart* has insured the proper application of this versatile product in many production emergencies. Alert production executives will find these aids of great help in answering troublesome metal-working problems. D. A. Stuart Oil Co., Ltd., 2733 S. Troy Street, Chicago 23, Illinois.

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LIMITED
ESTABLISHED 1865
Stocks in Principal Metal-Working Centers

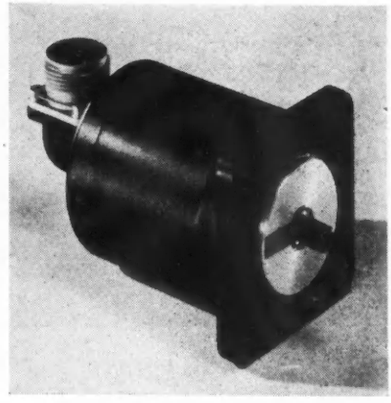
fied for the windshields and enclosures on several light planes. It also will be used for the entire top sections of sight-seeing buses operated by a New York concern.

The new material is being manufactured in clear and green transparent sheets, the latter offering antiglare properties in addition to filtering out the harmful portion of ultraviolet. The green transparent sheeting was used for enclosures on the B-25 bomber and the CG-4 glider during the latter part of the war.

Compact Tachometer Generator

A compact tachometer generator weighing less than 23 oz has been developed by the Kollsman Instrument Division of Square D Co., 80 45th Ave., Elmhurst, N. Y. The Compak generator operates a three-phase electric tachometer indicator of either the standard, sensitive or dual type, to provide a pilot with accurate indication of a plane's engine speed.

The improved generator is designed for use where tachometer indication for each engine is required at only one station and, like standard generators, operates from tachometer engine outlets rotating at one-half engine speed.



Kollsman Compak generator

Output of the unit is sufficient to actuate both a tachometer instrument and a synchroscope instrument and may be used with special Kollsman helicopter tachometers.

Where duplicate engine instruments are required the Compak generator may be operated at crankshaft speed, using a two-pole arrangement; the unit is then capable of actuating two tachometer indicators and, where desirable, a synchroscope. This adaptability feature is said to be specially useful in connection with new jet engine application.

Improved Light for Instrument Panels

The Fairchild Camera & Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y., has redesigned its Moonglo

(*Turn to page* 76, *please*)

HOW EXPLOSIVE RIVETS HELP SIMPLIFY "RUSH" MAINTENANCE WORK

Side panel to be replaced? Normally a tough and troublesome job. The Philadelphia Transportation Co., operating more than 800 busses and trackless trolleys, simplifies the job with Du Pont Explosive Rivets.

HERE'S HOW:

We will gladly help you determine how Du Pont Explosive Rivets may save you time and simplify the work on maintenance jobs. E. I. du Pont de Nemours & Co. (Inc.), Explosives Department, Wilmington 98, Delaware.

The Industrial-Type Explosive Rivet showing straight cavity extending full length of shank. When the Rivet is fired, the shank expands through its entire length. Photo shows cross-section of Rivet before and after expansion.

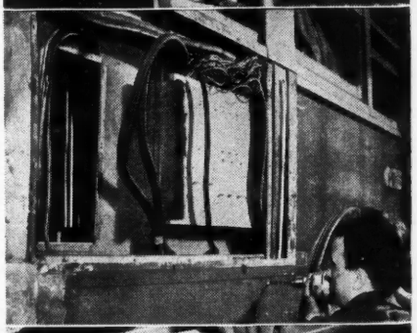
DU PONT EXPLOSIVE RIVETS

A Product of Du Pont Explosives Research

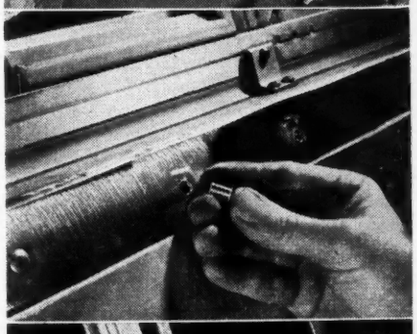
DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING ... *THROUGH CHEMISTRY*

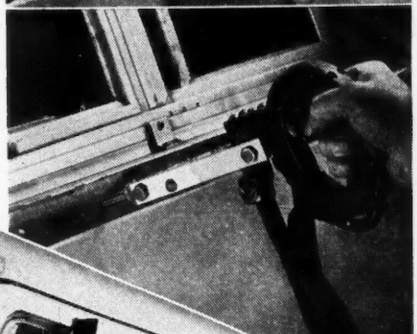
1. Damaged outside panels of passenger bus have been removed and holes drilled for panel replacement using Explosive Rivets.



2. Note that inside panels, and the complicated system of piping and wiring, have *not* been removed . . . saving hours of work.



3. Inserting Explosive Rivets in drilled holes after placing new panel in position. Rigid tolerances are not required.



4. Electrically heated Du Pont Riveting Iron fires charge in Rivet shank, causing it to expand, completely fill the hole and securely lock the Rivet in place. Takes less than 2 seconds!

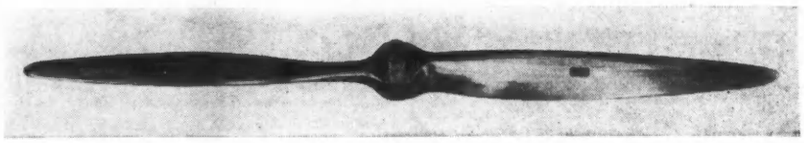
5. Explosive Rivets require no after-operations. Rivet heads are neat, smooth, ready for painting or finishing.

instrument light. A small cylindrical device about the size of a key ring flashlight, and operating off the airplane's electrical supply, it measures 1⅛ in. in diameter and 3½ in. in length, and weighs five oz. To give selective instrument panel lighting, it projects a beam of soft, even light that provides illumination for complete instrument panels in the pilot's compartment, or small panels and individual instruments at navigator's or radio operator's stations. It is also used to light radio instrument panels at side of cockpit, and is good for map-reading.

Its light intensity can be regulated by turning a large knurled ring at its forward end. This ring actuates a diaphragm, reducing the light intensity evenly over the entire area covered by the beam, but it does not affect the size or shape of the beam or alter its color value.

A mounting lug provided on the illuminator permits attachment to the airplane structure by means of a Fokker type tube clamp or any simple bracket.

Metal Propeller for Light Planes

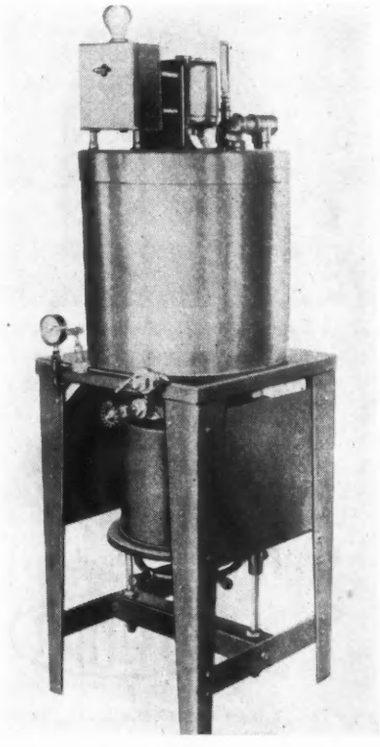


This thin-sectioned propeller, made of forged aluminum, is now available to owners of light planes. Known as the Met-L-Prop, it will be supplied for use with Continental A65, A75, C75, and C85 engines. The new propeller is manufactured by the McCauley Corp., 1840 Howell St., Dayton 7, Ohio.

Oil Refiner for Air Transport Companies

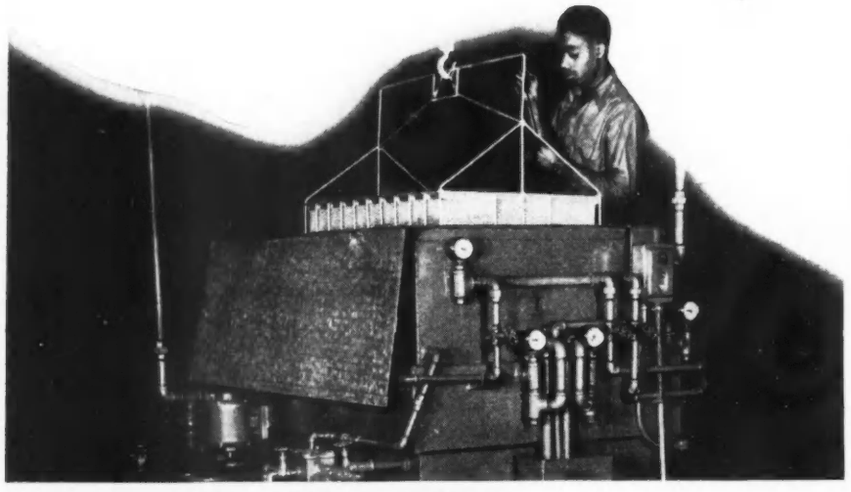
An oil refiner especially adaptable for airports is now in production at the Youngstown-Miller Co., 675 Main St., Belleville, N. J. The refiner is said to remove both the solid and the dissolved impurities and to employ a process that goes beyond ordinary reclaiming methods. Re-refining employs the process of contact filtration—simulating the process used in the refining of crude oil. In this process, the dirty oil is pumped to a heating chamber under

(*Turn to page* 80, *please*)



Oil refiner made by Youngstown-Miller Co.

SMALL DEGREASERS FOR BIG JOBS



DETREX VS-800

Standard Detrex VS-800 solvent vapor degreasers—both steam- and gas-heated—are filling requirements in many shops where difficult cleaning operations are encountered, and where floor space is at a premium.

Available in many different sizes, the VS-800 has work clearances slightly less than the overall dimensions of the unit. Solvent vapors and a spray of clean solvent distillate effectively removes the oils, greases, waxes and insoluble soils encountered in metal processing. Caked-on dirt, particularly, is easily taken off by the jet of warm solvent. Work emerges clean and dry, ready for further processing.

A Detrex field representative is located near you. For complete information, call one today.

DETREX Corporation
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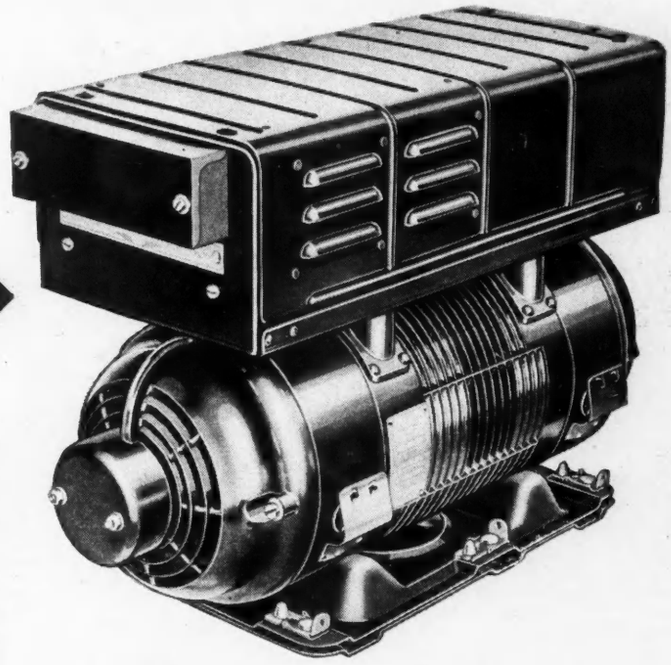
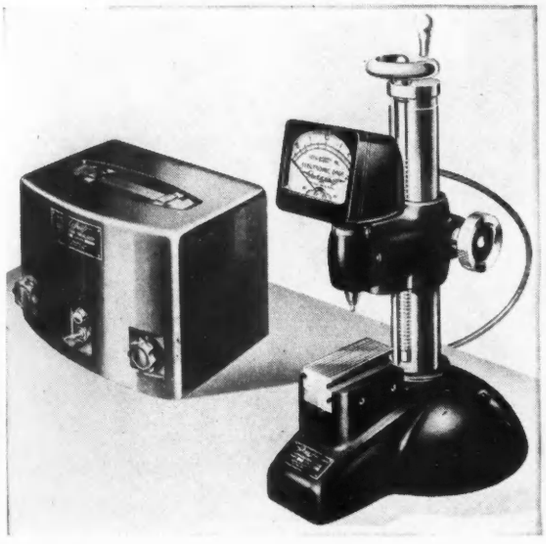
E-123

J & H Aircraft Products. We're continuing the manufacture of all well-known Jack & Heintz aircraft products—

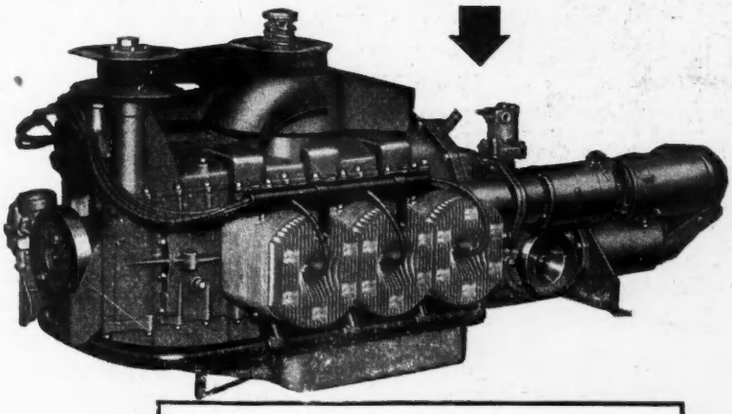
The 2500 volt ampere inverter that tips the scales at only 54 lbs., and provides a continuous and dependable source of 400 cycle, 115 volt AC power of the quality required for aircraft, radio and electronic applications.



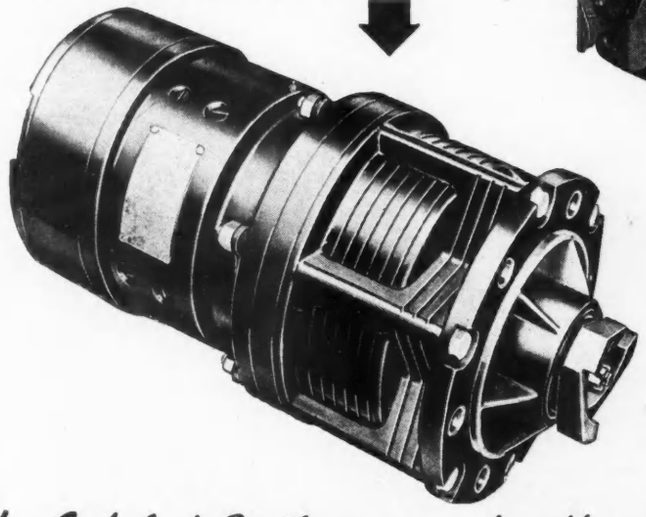


J & H Electronic Gages. Such as the widely used comparator that measures to millionths of an inch.

J & H Engines. Now undergoing tests. Will be suitable for automobiles, trucks and stationary usages, and will deliver more horsepower per pound or cubic inch displacement than any comparable engine on the market.



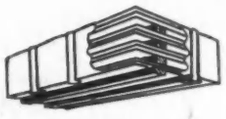
Lightweight universal aircraft electric starters with a heavyweight punch, capable of cranking the largest engines, yet light enough for smaller engines.



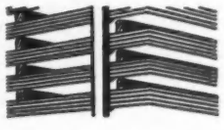
Jack & Heintz
PRECISION INDUSTRIES INC.
JAHCO

Yes Sir! Jack & Heintz is on the job! **JACK & HEINTZ PRECISION INDUSTRIES, INC., CLEVELAND 1, OHIO**

NEW NOX-RUST WOODSEAL ELIMINATES "WASTER" SHEETS, CUTS LABOR AND MATERIAL COSTS!



SHIPPING Losses due to rust from wood skids and costs of paper wrapping are high.



STORAGE Wood separators and racks rust adjacent steel sheets and shapes.

WASTERS are sheets spoiled by rust marks and residues at points of contact with wood.

No longer need the cost of wood rusted steel run to millions of dollars annually. Nor must hundreds of thousands be spent on paper and metal wrappings to protect steel from wood during shipping and storage. Moisture and corrosive sap can now be permanently "locked" in green wood skids, separators, crates and boxes.

Nox-Rust WoodSeal, developed in our laboratories at the request of a leading steel producer, is simply applied, will not come off, and gives positive protection against rust and residues injurious to tools. If you *make, ship, store* or *use* steel, we suggest you drop us a line for further information on WoodSeal.

We shall be glad to send on request our new catalog describing other Nox-Rust chemicals and protective coatings.

Chemicals for American Industry

NOX-RUST

CHEMICAL CORPORATION

2433 SOUTH HALSTED STREET, CHICAGO 8, ILLINOIS

automatic float control and adsorbent earth is added in suitable proportion. The two are then thoroughly mixed by means of an agitator and are heated by electricity. Heating and mixing are of sufficient duration to utilize fully the adsorbent material and to drive off volatile contaminants.

The removal of volatiles is hastened by the evaporative effects of a continuous stream of fresh air which is passed across the oil surface, permitting lower operating temperatures than would otherwise be possible.

Heaters are under thermostatic control and go off automatically at the proper temperature—a signal light indicating this occurrence to the operator.

The oil and earth mixture is then dropped by the operator to a transfer tank from which it is forced into a two stage filter press by air pressure. Here all solids, including the adsorbent materials, are removed. The clean oil may be piped from the filter press to any suitable storage facility or returned to engines under pressure.

Ramps for Loading and Unloading Planes

The Glenn L. Martin Co., Baltimore, Md., is manufacturing a series of ramps for loading and unloading planes. Chief of these is a new adjustable passenger ramp which is designed for use with any airplane which has an entrance door sill within the range of a minimum of 86 to approximately 126 in. above the ground.

Constructed entirely of aluminum alloy, the new accessory is built in four major sections: truck, support, lower steps and upper steps.

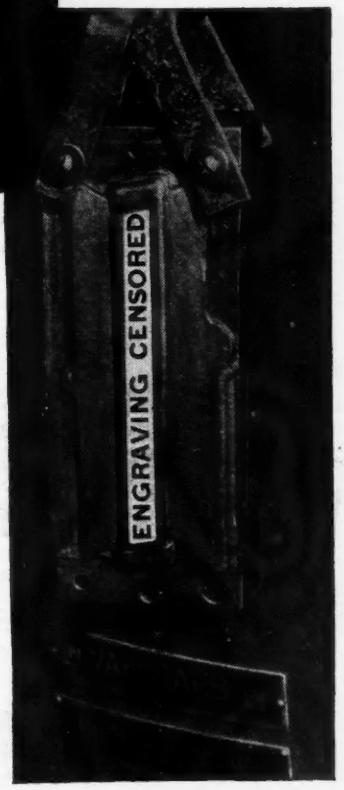
The truck is mounted on two 16-in. fixed wheels and two 16-in. casters. Positive-lock brakes are provided on both wheels and casters so there will be no possible chance of the ramp moving away from the side of the plane when passengers are boarding or alighting from the air liner.

Martin ramp

TOOLING UP?

Punches and Dies Should Last Longer if They are Vapocarb-Hump Hardened

Croname Inc. gets "perfect" heat-treating results when expensively-engraved tools like these are Vapocarb - Hump hardened.



Three considerations have led Croname Inc., Chicago, specialists in fine metalcraft, to use the Vapocarb-Hump method for hardening the big dies required for their customers' work.

1. Experience. Most methods of hardening and most tricks of the trade have been known and used by Croname, and Vapocarb-Hump hardening has been selected as a result of this experience. The Vapocarb-Hump method protects the engraved surfaces against both scale and decarburization; it automatically maintains temperature with great accuracy; it records the temperature of the die itself; it records (and can control) the difference between temperature of die and that of furnace wall. With all these features at his command, the heat-treater is able to harden both hobs and dies for longest life and greatest production.

2. Investment. These big tools represent much toolmakers' time and up to several hundred pounds of fine tool steel. Croname protects this investment by Vapocarb-Hump hardening.

3. Customer-pleasing. When it takes several weeks to make the dies for an order, the schedule obviously won't stretch to accommodate extra toolmaking. Croname has found that Vapocarb-Hump Hardening helps the heat-treater to do every job right, and on time.

- - -

If you have a tool heat-treating problem, an L&N engineer will gladly call to talk it over, or will send a Vapocarb-Hump Catalog, as you prefer.

LEEDS & NORTHRUP COMPANY, 4966 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl. Ad. T-621(35)

Automobile Developments That Came Too Soon

(*Continued from page* 22)

of aluminum hammered out on high speed power hammers. At that time aluminum was not rolled in sheets that were wide enough. We solved this difficulty by working out a method of acetylene welding of two sheets. The welded sheet was then put under the power hammers and the seam worked down so that it was uniform with the rest of the sheet. The finished roof was indistinguishable from a single sheet and we never had any trouble with them."

The Maxwell-Briscoe Co. in 1903 also produced metal bodies. These early metal bodies, however, differed greatly from the present type assembled from die-formed stampings by electric welding. With few exceptions, they were open bodies and they comprised a framework of either wood or steel, to which the metal panels were secured by screws and rivets.

One objection to most of these early metal bodies was that they were quite noisy. The earliest closed bodies were of wood, and the silencing problem in the case of metal construction was even more difficult in their case. Gradually methods of soundproofing or insulating these metal bodies were developed, but roofs of closed so-called all-metal bodies continued, at least with the exception noted, to be made of soft material until about a decade ago, when General Motors (Fisher Body Div.) introduced its "turret" top.

Disk Wheels

Another feature of our modern cars which it took a long time to achieve recognition is the disk wheel. At present practically all cars carry such wheels, for although some of them may be referred to as spoked wheels, the hub is always joined to the rim by a single member made of malleable steel by rolling or forging processes. Certain advantages of disk wheels were recognized quite early. They are easily cleaned, and they offer great resistance to shock. These wheels came into limited use some 30 years ago. What retarded their general adoption was the unattractive appearance of these early examples. Through familiarity with buggy wheels with long, light hickory spokes, and with bicycle wheels with wire spokes, people had acquired the notion that wheels should be light in appearance. The early disk wheels, of diameters ranging between 32 and 36 in. and fitted with high-pressure tires of from 3½ to 4½ in. section, reminded one of the solid wooden disk wheels of the ox carts of an earlier epoch, and they certainly did not satisfy the esthetic sense of the time. The situation changed completely when wheel diameters were reduced to 27 or 28 in. and when, with the introduction of low-pressure tires, sectional diameters of the tires were almost doubled. There was then so little space left between rim and hub that the use of separate spokes became almost an impossibility. This development, of course, came gradually, and views as to what wheels should look like changed at the same time. In modern disk wheels the disk portion has comparatively little weight, and this is one of the factors which have made it practical to replace the former demountable rims by demountable wheels.

Front-Wheel Drive

We are this year witnessing the reintroduction of front-wheel drive for passenger cars, which recalls the fact that this drive was very much to the fore in automobile-engineering discussions for a certain period about 15 years ago. At that time various priority claims were put forward, but a search of the records showed that none of them had any validity, and that the

(*Turn to page* 84, *please*)

You can depend on—

BORG & BECK

For that vital spot where Power takes hold of the load!

Engineered by Borg & Beck

means . . . designed and built by highly-trained men whose skills are completely concentrated on the making of finer Borg & Beck clutches!

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ENGINEERING B-W PRODUCTION

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CHICAGO, ILLINOIS

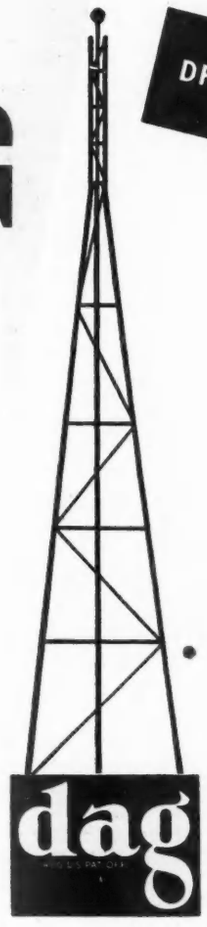
Problems like these spell out D-A-G

PRESS-FITTING CYLINDER LINERS

BLEEDING STATIC ELECTRICITY

DRY-FILM LUBRICATION

IMPROVING BROACH LIFE (SOFT METALS)



Problems like these spell out D-A-G in the automotive and aviation industries—because the unique properties of that unique product, "dag" colloidal graphite, have spelled out their solutions so often.

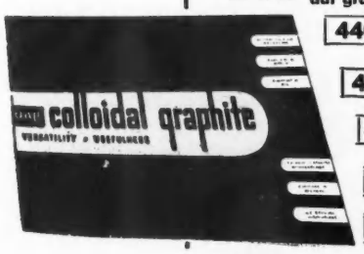
"Dag" colloidal graphite has properties which make it ideal for very high and very low temperature lubrication, for parting and preventing seizure, for forming electrically conductive films, for coating and impregnation, and for a host of special purposes. It is available as a stable dispersion in water, oils, volatiles, alcohols, glycerines, and other carriers. It finds as many uses in industry as 19 significant properties and 18 dispersions find functions to serve —and that's scores.

For evaluating those 19 properties and 18 dispersions in terms of *your* interest, write for the specialized literature listed below—and see if *your* problems don't spell out D-A-G.

dag

colloidal products

ACHESON COLLOIDS CORPORATION, Port Huron, Mich.



This new literature on "dag" colloidal graphite is yours for the asking:

- 430 — A general booklet on the story of "dag" colloidal graphite. 12 pages profusely illustrated. ☐
- 440 — A complete list of "dag" colloidal graphite dispersions with applications. ☐
- 421 — Facts about "dag" colloidal graphite for ASSEMBLING AND RUNNING-IN ENGINES AND MACHINERY. ☐
- 422 — Facts about "dag" colloidal graphite as a PARTING COMPOUND. ☐
- 423 — Facts about "dag" colloidal graphite as a HIGH TEMPERATURE LUBRICANT. ☐
- 431 — Facts about "dag" colloidal graphite for IMPREGNATION AND SURFACE COATINGS. ☐
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ACHESON COLLOIDS CORPORATION
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Please send me without obligation, a copy of each of the bulletins checked:

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OUR PRESENT OIL SUPPLIER IS_____

(Lubricants containing "dag" colloidal graphite are available from major oil companies.)

This up-to-the-minute news-picture magazine shows how wide-awake management in many lines of business is utilizing palletized unit loads and fork trucks . . . to end the burden of costly manual methods and speed production.

GOOD NEWS FOR HIGHWAY SHIPPERS

Mechanized handling made available to highway shippers by the new Clark Trucloader Method.

Clark builds GAS AND ELECTRIC POWERED FORK TRUCKS AND INDUSTRIAL TRACTORS

CLARK TRUCTRACTOR
Division of CLARK EQUIPMENT COMPANY
BATTLE CREEK, MICHIGAN
OTHER PLANTS — BUCHANAN, JACKSON, BERRIEN SPRINGS, MICHIGAN

CLARK TRUCTRACTOR, 1001 24th St., Battle Creek, Mich.
☐ HAVE YOUR NEAREST FIELD ENGINEER CALL.
☐ SEND US COPY OF MATERIAL HANDLING NEWS.

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COMPANY_____

CITY_____ STATE_____

practice was much older than was generally believed. Front-wheel drive—albeit in a very crude form—was used in the first motor-propelled vehicle of which there is an authentic record—the Cugnot three-wheeled steam truck of 1769, and also in what was probably the first design of a gasoline automobile, that disclosed by the Selden patent, for which application was made in 1877. Cugnot used front-wheel drive because in his days neither the Ackermann steering gear nor the differential gear had been invented, and he decided to combine the functions of driving and steering in a single front wheel, which had what may be described as a combined steering-fork and fifth-wheel mounting. The entire powerplant, including the boiler, turned with the front wheel in steering.

Selden also employed fifth-wheel steering and mounted the powerplant on the fore-carriage, so that it turned with the front axle. A car in accordance with his patent specification was built during the early years of the current century, in connection with the prosecution of the Selden patent suit, to prove that it would have been possible at the time of application, in 1877, with the knowledge then available, to build a workable road vehicle in line with the specifications and drawings of the patent.

When automobile production actually began, during the closing years of the past century, rear-wheel drive was used almost without exception, because it is simpler to drive through wheels not used for steering, and front-wheel has advantages over rear-wheel steering. Besides, under adverse conditions, greater traction can be secured with rear wheels, because with the weight equally divided between front and rear with the vehicle at rest on the level, on a steep up-grade both the inclination and the torque reaction transfer weight from the front to the rear wheels, thereby increasing the adhesion of the latter and decreasing that of the former.

To most of us automobile history began in 1895, with the *Times-Herald* race, or a few years earlier if we want to include European developments, and both the Cugnot and the Selden vehicles therefore may be regarded as prehistoric types. The real pioneer of front-wheel drive in this country was Walter Christie of New York, who specialized in racing cars and motor-propelled war chariots, including the amphibian type. A front-wheel drive construction brought out by him in 1904 is shown in Fig. 7. It will be seen that the entire powerplant is mounted transversely between the front wheels. In direct drive the wheels are coupled directly to the crankshaft. Christie used this construction successfully in track racing.

Toward the end of the nineteen-twenties a wave of interest in front-wheel drive was stirred up in this country, and two distinct models were

(*Turn to page* 88, *please*)

..the Acme-Gridley

CHUCK-MATIC

SINGLE SPINDLE 12" CHUCKER

For heavy duty, high production work on castings, forgings and tubing parts. Specializes on such primary operations as straight or taper boring, form boring or form turning, drilling, turning, forming, facing and chamfering.

The 12" Chuck-Matic is an entirely new design. It is an air-operated automatic, especially suited to cutting machine costs on short runs as well as long runs.

IT IS RUGGED—Heavy frame and new design gives you every advantage of modern tooling methods. Maintains precision, undisturbed by heavy feeds with high speed or carbide tipped tools.

IT IS FAST—Idle movements are cut to the minimum. Setup is quick and easy. Quick change from job to job. Adjustments easy through unusual accessibility.

UNSKILLED OPERATORS can run it. Automatic safety devices control both manual functions and mechanical movements—protecting operator, work and machine.

SPACE SAVING is a special advantage. Floor space required, 45" x 64". Convenient to locate. Operator can tend as many machines as job cycle times will permit.

★

THIS NEW BOOK—Bulletin SC-46 gives you complete details and specifications. Send for your copy.

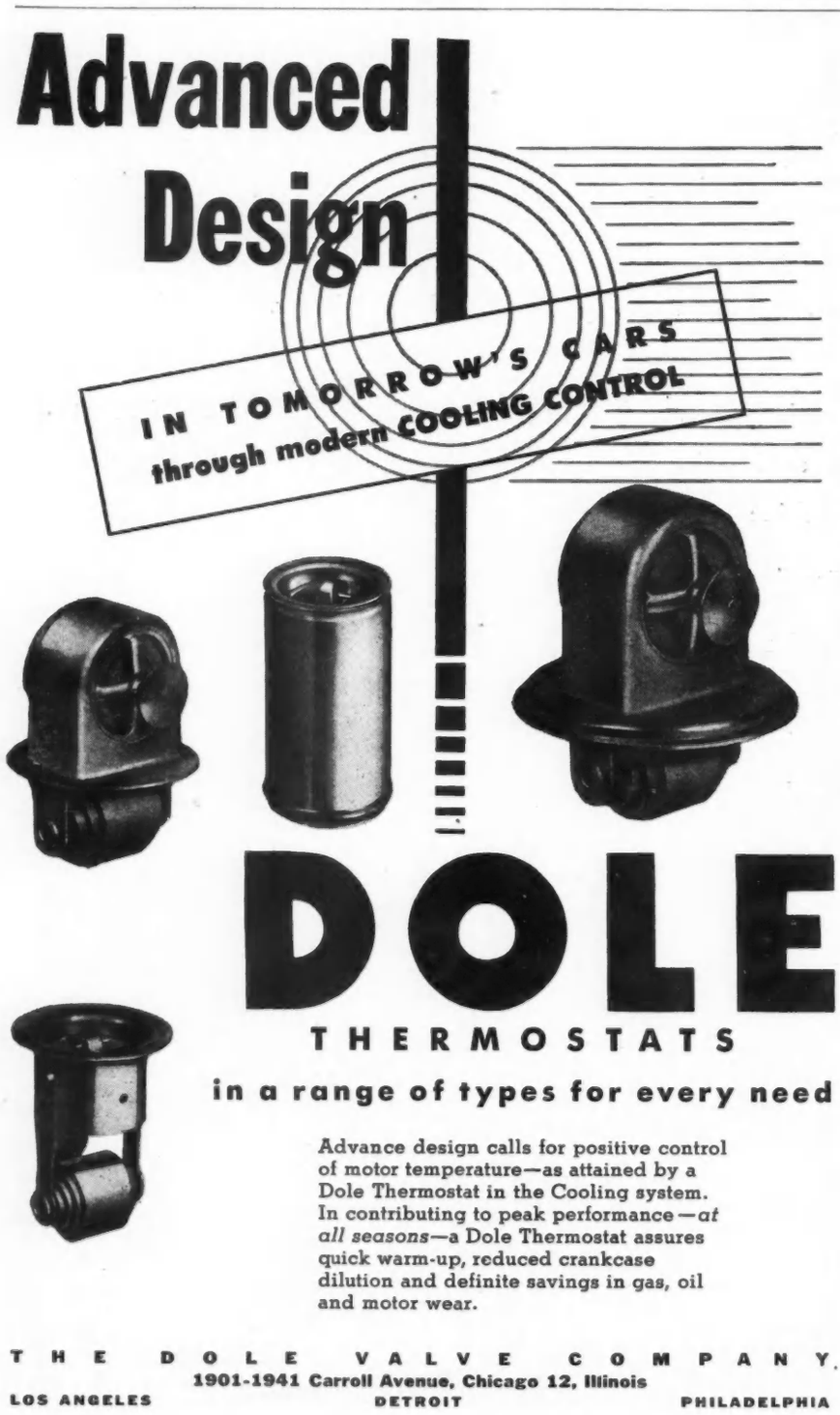
The NATIONAL ACME CO.

170 EAST 131st STREET • CLEVELAND 8, OHIO

Acme-Gridley 4-6 and 8 Spindle Bar and Chucking Automatics • Single Spindle Automatics • Automatic Threading Dies and Taps • The Chronolog • Limit, Motor Starter and Control Station Switches • Solenoids Centrifuges • Contract Manufacturing

produced, the Cord and the Ruxton. At that time both the Ackermann steering gear and the differential gear were in general use, and the motives of the new proponents of front-wheel drive therefore were entirly different from those of Cugnot and Selden. The aim now was to make it possible to lower the car body without providing a deep tunnel in the floor for the propeller shaft, which always was a source of discomfort to rear-seat occupants. The two front-driven models of that period were conspicuous for their low build. This afforded a pleasant feeling of security to passengers, but was not quite so satisfactory from the driver's standpoint, as the high hood in front of him cut off his view of the road immediately ahead. A group of persons directly or indirectly interested in the production of one of the vehicles at one time was out for a spin in it, when they were overtaken by a large car of conventional construction, which to them seemed to tower high above them. One of the party, impressed by the difference in height, instinctively asked "What make of car was that?" and was informed that it was an "antediluvian" X car. The car mentioned actually had been equipped for at least four years with hypoid-gear drive, which also is designed to permit of low construction, and if the specimen involved actually was of that make it must have been of a pre-hypoid vintage.

The front-wheel drive movement of the late twenties and early thirties was not crowned with success, but the test given the feature at that time was not really conclusive. The Cord car was produced—and sold at least moderately well—for a number of years, and its production was discontinued only because the Auburn Co., which also produced rear-driven cars, went out of business. The Ruxton never went into production. Both designs were handicapped in that eight-cylinder in-line engines were used, which are ill adapted to front drive because of their great length, making it difficult to get sufficient weight on the driving wheels. Finally, the introduction of these cars was followed at a short interval by one of the worst business depressions of recent times, during which it was difficult to sell cars incorporating radical innovations, which must be sold at prices that take care of considerable development costs.


Advanced Design
IN TOMORROW'S CARS
through modern COOLING CONTROL
DOLE
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in a range of types for every need
Advance design calls for positive control of motor temperature—as attained by a Dole Thermostat in the Cooling system. In contributing to peak performance—at all seasons—a Dole Thermostat assures quick warm-up, reduced crankcase dilution and definite savings in gas, oil and motor wear.
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Bendix-Westinghouse Opens Four Regional Offices

In an effort to bring closer personal contact into its rapidly expanding field of operation, the Bendix-Westinghouse Automotive Air Brake Company of Elyria, Ohio, has opened new regional offices in New York, Detroit, Atlanta and Dallas.

The New York office, now handling the contacts of the Philadelphia office it supersedes, is located at 8206-7 Empire State Building and will be under the supervision of A. R. Leukhardt, regional manager. In Detroit, J. V. Ralston, assistant regional manager, will direct the company's activities from offices at 217 in the Boulevard Building. E. W. McKay, regional manager, will represent the company in Atlanta from headquarters at 69 Mills Street, N.W., and W. H. Parish, regional manager, will be in charge of the Dallas office at 313 Andrews Building.

Duridine 210 B

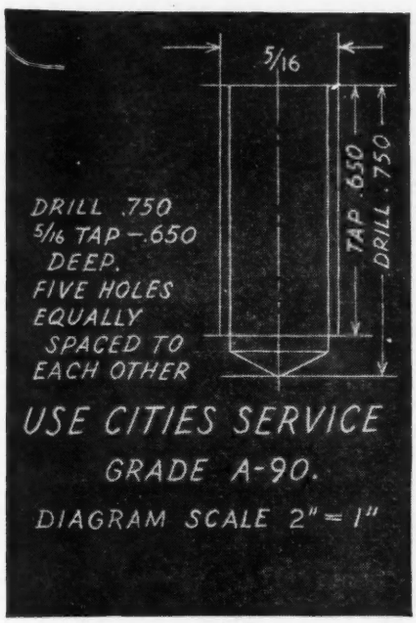
Duridine 210 B (the new name for 210 B Deoxidine) has been selected by the American Chemical Paint Co. as a more descriptive name for the distinctive characteristics of the product. It also eliminates the confusion which occurred, due to its functions differing from those properties which characterize the original Deoxidines.

The thin, tight, relatively hard phosphate coating which is developed on metal surfaces, when cleaned with Duridine 210 B, prevents rust and provides an adequate surface to bind paint to the metal for an enduring lustrous finish.

METAL-CUTTING LUBRICATION

Problem and Solution in Tapping Stainless Steel

TAPPED TO A DEPTH OF ¾" CHIPS WOULD TEAR THREADS AS TAP WAS BACKED OUT

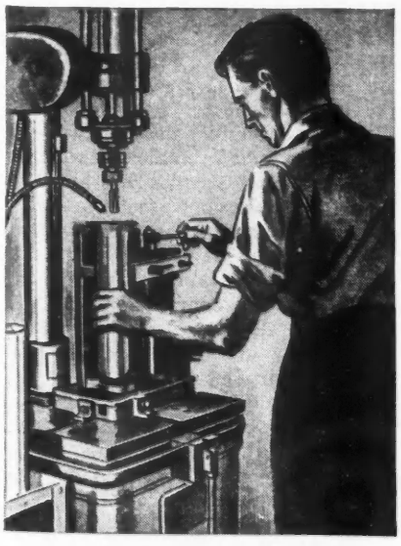


Knowledge of lubrication and your specific machining operation often combine to solve a stubborn and costly metal-cutting problem . . .

Lubrication Engineer's Report

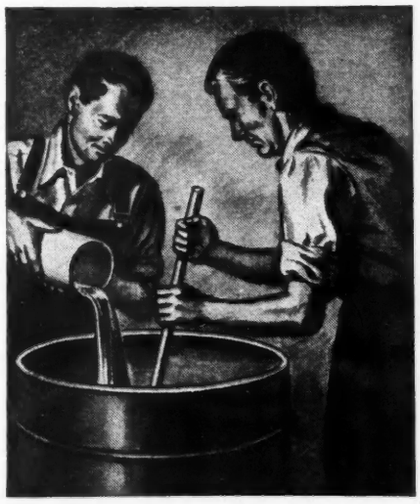
"White Rodgers Electric Company has been buying our Chillo 1000 and using it to blend their own cutting oils. Recently, they seemed to be having a difficult time in tapping 430 Stainless Steel.

"When I checked the job, they were using Chillo 1000 with the characteristic attitude that if 1 gallon of base to 5 gal. of mineral oil is good,



then 2 gal. of base should be twice as good. This was carried to the point where they were using a 50-50 mixture which was very viscous and obviously not cooling the work nor reaching the cutting end of the tap.

"The 430 Stainless Steel tore badly when tapped to a depth of ¾ inches with a 5/16 inch tap. It was a blind



hole and apparently the threads were being torn by the chips when the tap was backed out. Since the blind hole had plenty of chip clearance in the bottom below the threaded section, we changed from a 3 fluted tap to a 2 fluted tap with a "Gun Groove" ground in the end to throw all the chips forward and thus not interfere with backing out the tap.

Blending Problem Avoided

"This seemed to help quite a bit. However, the oil was still not reaching the cutting end of the tap.

"We recommended Cities Service Grade A-90 for this job, because we felt that it had the necessary additives and would avoid the blending problems encountered with Chillo 1000.

"Grade A-90 has proved so satisfactory that White Rodgers are using it on all stainless steel. In addition, the Engineering Department is specifying Grade A-90 on all prints of stainless steel jobs along with recommended cutting speeds."

Through continual contact with the lubrication problems encountered by industry over the years, Cities Service Lubrication Engineers have accumulated considerable information on ways and means for reducing costs and improving the performance of lubricants. See for yourself how they can help *you*. Contact your nearest Cities Service branch office or write to Cities Service Oil Company, 60 Wall Tower, New York 5, New York.

Expert Counsel Available

CITIES SERVICE OILS
ONCE-ALWAYS

FOR EVERY LUBRICATION PROBLEM CALL Cities Service FIRST!

Warner Electric Brake

(*Continued from page* 29)

essentially, of the following elements: the electro-magnet, the armature, backing plate, brake shoe assemblies, and the brake drum. The magnet, as will be seen later, is mounted integrally as a part of the backing plate and is the stationary element while the armature is bolted to the brake drum and is the rotating element. The two constitute the clutch member. As illustrated, the magnet is faced with a friction lining. The armature is faced with Armco iron segments to provide the most efficient path for the magnetic circuit and is held with light spring pressure.

In operation the brake is actuated by the special Warner controller, operated either by hand or by foot, so as to permit the driver to apply the proper amount of braking effort. As the lever is moved electric current flows through the electro-magnet and sets up dense lines of flux which bind the magnet to the revolving armature. The resulting clutch action tends to retard the brake drum, thus utilizing the energy of the moving vehicle to complete the brake application.

In effect, the magnet tends to move with the brake drum and in so doing it presses the brake shoe cam against the shoe, forcing it outwardly to contact the brake drum. Obviously the sequence of operations thus described takes place almost instantaneously, although it takes time to outline the events in a word picture. Actually, the magnetic circuit operates on the normal six-volt storage battery of the vehicle and normally requires only 18 watts of energy.

The floating two-shoe brake described above is made in two types—adjustable and non-adjustable, the adjustable type being recommended for extremely heavy service to compensate for progressive lining wear. However, the outstanding feature common to both is that of "balance" and controllability, making them particularly adaptable for front wheel application. Each shoe is energized separately by the clutch, equally in either direction of rotation, and the resulting radial forces on the drum are equal and opposite at every point on the periphery. Fig. 2 is an exploded view of this brake, showing all of its component parts.

The hinged type brake is comparable in its mechanical setup to a conventional brake system with single cam actuation of the ends of the two shoes. Unlike the floating type described above, the hinged type is self-energizing in action.

The "compound" brake is of unique design developed originally for the 120 mm gun carriage and is applicable to vehicles of unusually high GVW ratings. For example, the unit shown in Fig. 3 was used on a carriage having a gross weight of 62,000 pounds and is capable of absorbing 240,000 lb in. of torque. When you deal with forces of this magnitude it is impractical to provide a magnetic circuit having sufficient torque to actuate the brake through a single set of cams. Consequently, the brake mechanism is "compounded" in the form of a main balanced two-shoe brake and a small balanced two-shoe brake which floats freely on a bearing. The magnetic clutch is combined with the auxiliary brake so as to utilize the torque of the clutch and the small brake for energizing the main brake system. By this means an enormous torque capacity can be developed with a magnet torque of only around one per cent of the total braking effort.

The latest addition to the line is the supplementary eddy-current brake intended to meet the requirements of city bus service, mountain transport service, and for other operations where dynamic braking will relieve the arduous duty imposed on the wheel brakes. It is intended to supplement wheel brakes rather than to supplant them; and accordingly will be mounted on the chassis entirely apart from the wheels. The eddy current brake relieves the

(*Turn to page* 92, *please*)

Speedy, Low Cost Fastening

OF
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HOOD & TRUNK
MEDALLIONS
TAIL AND
PARKING LIGHTS
ETC.

WASHER TYPE
PALNUTS

Handle ONE part instead of THREE

THESE inexpensive one-piece, self-locking Palnuts perform the same function as regular nut, lockwasher and plain washer combined. You not only replace three parts with a single Palnut, but power drivers may be used to further speed up assembly. Special sockets for power drivers pick up, spin on and tighten Palnuts in one operation. Once tightened, Palnuts stay tight under vibration — assured by their exclusive double locking spring action.

Send for samples. Ask for engineering literature on entire Palnut fastening line.

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SUPERIOR ABRASION RESISTANCE

Parts made from HYCAR synthetic rubber have 50% greater abrasion resistance than parts made from natural rubber. That means they'll last longer, give more dependable performance in the most severe service, and save maintenance and replacement time.

But that's only one of HYCAR's unusual and valuable properties. Examine the list in the box at the right. Think of these properties in terms of your requirements of rubber parts. Realize that these properties may be had in an almost limitless number of combinations, each designed to meet the specific service conditions of the finished part.

We have developed more than 5000 recipes for HYCAR compounds — each compound engineered to do a certain job. If you're looking for rubber parts that will give long life, dependability, and economical operation, *specify HYCAR.*

Ask your supplier for parts made from HYCAR. Test them in your own applications, difficult or routine. You'll learn for yourself that it's wise to use HYCAR for long-time, dependable performance. For more information, please write Department HH-5, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

CHECK THESE SUPERIOR FEATURES OF HYCAR

1. *EXTREME OIL RESISTANCE — insuring dimensional stability of parts.*
2. *HIGH TEMPERATURE RESISTANCE—up to 250° F. dry heat; up to 300° F. hot oil.*
3. *ABRASION RESISTANCE—50% greater than natural rubber.*
4. *MINIMUM COLD FLOW—even at elevated temperatures.*
5. *LOW TEMPERATURE FLEXIBILITY—down to —65° F.*
6. *LIGHT WEIGHT—15% to 25% lighter than many other synthetic rubbers.*
7. *AGE RESISTANCE—exceptionally resistant to checking or cracking from oxidation.*
8. *HARDNESS RANGE—compounds can be varied from extremely soft to bone hard.*
9. *NON-ADHERENT TO METAL—compounds will not adhere to metals even after prolonged contact under pressure. (Metal adhesions can be readily obtained when desired.)*

Hycar

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Synthetic Rubber

B. F. Goodrich Chemical Company

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Discharge end of an EF furnace brazing three-piece pulley assemblies.

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Are Securely and Economically Joined In EF Soldering and Brazing Furnaces

Products ranging in size from small intricate assemblies weighing a fraction of an ounce up to large assemblies weighing several pounds are being neatly and securely joined in EF continuous batch type brazing and soldering furnaces.

Products which otherwise would be difficult or expensive to make in one piece are being made in several pieces and brazed.

Products requiring several stampings joined or requiring screw machine parts, forgings and stampings to complete the unit, are being neatly and economically joined, right in the production line.

Strong, leak-proof joints are made and the completed units are discharged from these furnaces—clean and bright. Any number of joints in the same product or any number of pieces can be joined at one time.

ELECTRIC AND FUEL FIRED EF FURNACES

Investigate This Process For Joining Your Metal Parts

We will be glad to put samples of your products through one of our furnaces to show you the results you can expect, and give you an estimate on the cost of the equipment to handle your products and production, together with operating costs, if interested.

Send for printed matter showing various types of EF furnaces.

The Electric Furnace Co., Salem, Ohio

Gas Fired, Oil Fired and Electric Furnaces---For Any Process, Product or Production

wheel mounted brakes of most of the heat generated by traffic decelerations or due to holding to a safe speed on long grades. This will keep the normal braking system in good shape for service or emergency stops.

The general principle of operation may be visualized by reference to Fig. 4. The unit shown here is intended for mid-ships mounting under the trailer and under the tractor, necessitating a driving axle for the unit on the trailer. Here we find two sets of electromagnets mounted in a stationary position. The brake drum is the rotary member and is fitted with fan blades for the rapid dissipation of heat. There is no mechanical contact between the drum and magnet. One such an arrangement in a train may be seen schematically in Fig. 5.

Operation of this device is based upon the well known principle that when the lines of flux of a magnetic field are continuously cut, eddy currents will be set up in the rotating metallic portion of the circuit, the effort required to cut the flux resulting in a powerful retarding torque. In the arrangement shown here the eddy currents are set up in the brake drum and the energy is dissipated in the form of heat. By mounting the unit under the chassis and directly in the air stream, also by the use of a fan of proper capacity it is possible to develop sufficient cooling to keep the drum from warping or cracking. For each specific application, it is feasible to so proportion the magnetic circuit, air gap, and drum size as to develop the proper retarding torque.

In tractor-trailer combinations it is necessary to apply this dynamic system to all axles of both the tractor and trailer, and for the front axle of the tractor if need be. This is of particular moment when operating on icy roads since under those conditions the braking action must be distributed among as many wheels as possible so as to obtain maximum braking capacity without jackknifing.

One of the desirable features of the arrangement is that its action is automatic and requires no operations on the part of the driver. The unit can rotate at drive shaft speeds or at higher speeds, depending upon the nature of the installation. It does not require a battery and its electric system can be independent of that used for starting, lighting, or for electrical wheel brakes, save for certain interlocking of control which may be desirable. This independence of action comes from the use of an auxiliary generator driven from the same power train under the chassis and producing an adequate supply of current while the vehicle is in motion. One form of this unit requires a 12 volt generator with an output of 24 amp. It is of interest to find that the torque is constant over the entire range, except at very low speeds while the horsepower output goes up directly in proportion to speed.

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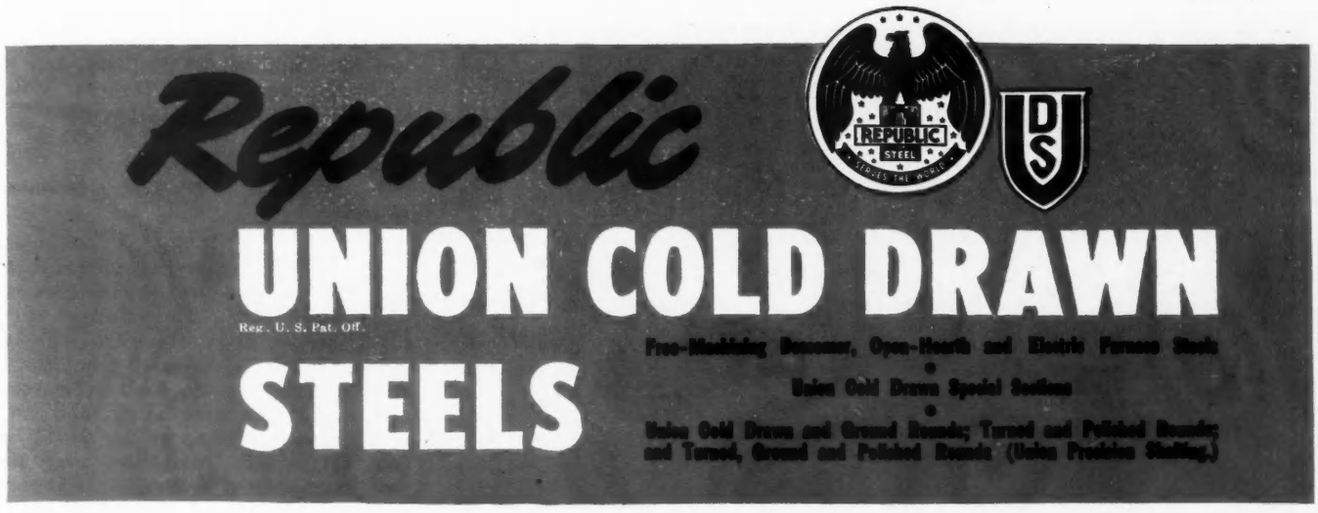

If you make duplicate steel parts from bar stock on a mass production basis, you need all the MACHINABILITY you can get in steel bars today.

And you'll find it in Republic Union Cold Drawn Steels.

Because of its vital importance in steel parts manufacture, MACHINABILITY *always* has rated above everything else at Union Drawn.

Metallurgists constantly seek new ways to improve it. Engineers study the performance of steels in order to fully utilize their machining qualities. And the workmen who produce the steels employ every modern method and control to insure maximum and uniform MACHINABILITY—including complete facilities of the latest type for furnace treatment.

That's why Republic Union Cold Drawn Steels produce steel parts with such smooth machined surfaces—at high speeds and heavy feeds—while extending tool life.

That's why users of these steels can realize the highest rate of output at lowest cost—resulting in greatest possible profits.

And that seems to be a very good reason why you should specify Republic Union Drawn Steels on every order for bar stock. If you need further reason—remember that Republic metallurgists and engineers always are ready to help you achieve top efficiency, output, quality and rock-bottom unit cost with these steels.

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MID AMERICA EXPOSITION CLEVELAND

Heavy Production Losses

(*Continued from page* 17)

apparent that the parts situation has either remained static or lost ground, and that the only reason for the upward climb in total production is the impetus of General Motors and Packard with accumulated inventories of components.

Just how serious the situation is can be seen from the following quotation taken from a letter to stockholders by K. T. Keller, president of Chrysler Corporation: "After having now attained the approximately 50 per cent production rate, the present prospect is that output now is on the decline, due principally to the indirect affects of strikes and other factors. Most materials and component parts are in a state of chronic short supply and the prospect for any substantial increase in the rate of production in the immediately foreseeable future is not good." He said further that "increases in the prices demanded by our vendors to compensate them for their higher costs already incurred incidental to the current wave of wage increases have already substantially raised to us the cost of materials and components from which our vehicles are built, and the eventual scale of these prices is not ascertainable. Stable prices on many substantial items remain to be determined."

The cost to the manufacturers, automobile dealers, and to labor because of lost production as a result of shutdowns chargeable to strikes in suppliers' plants has been monumental. Ford estimates that production losses to date exceed $242 million. Dealers lost about $48 million and Ford workers nearly $185 million. For Chrysler Corp. estimates of losses in these three categories are $225 million, $51 million, and $9 million, respectively. Hudson Motor Car Co. has estimated that its workers lost more than $1.6 million in wages during the Midland Steel Products strike that closed Hudson for a month.

According to industry spokesmen, the outlook for labor peace throughout the parts industry over the next several weeks is not good. The principal cause of strikes at present is disputes over wage increases. While many parts suppliers have settled their differences, others still are negotiating, and with new contracts coming up for consideration by several companies over the next few months, production is expected to be spotty. The general settlement in the Detroit area has followed the 18 cents an hour pattern established in the automobile manufacturing plants. However, settlements for lesser amounts have been negotiated in smaller centers away from Detroit, but in some cases only for a period of six months or so, and trouble may crop out again when this interim period expires. The greatest trouble arises from the fact that many parts manufacturers were able to increase wages considerably during the war, some as much as 50 per cent over prewar levels. Now the unions are insisting that regardless of previous increases, a flat 18 cents be granted. In many instances, this brings the rate among parts makers considerably above the rate prevailing in automobile plants.

Another trend developing in the parts industry, as well as in others, is the effort of unions to scrap all existing incentive wage plans. Some parts companies already are reporting that labor is getting tough on this question and a real fight may yet develop. Incentive plans are generally more prevalent in parts plants than in those of assemblers. The present indication is that parts manufacturers are going to resist firmly any effort on the part of labor to substitute straight hourly rates where incentive plans now are working. If the unions persist in that course, strikes are bound to come.

JOHNSON manufactures Hydraulic Tappets, Self Locking Adjustable Tappets, and conventional Adjustable Tappets... JOHNSON builds tappets to your designs and specifications... Let JOHNSON assist you in your tappet design problems.

(The above illustration is a sectional and exploded view of JOHNSON Hy-Precision Hydraulic Tappet.)

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MUSKEGON HEIGHTS, MICHIGAN

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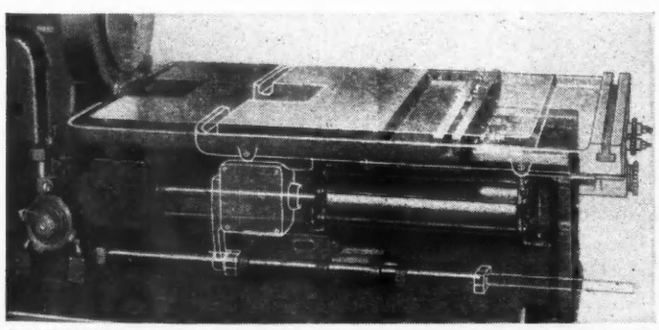
...FOR HEAVY, FAST PRODUCTION

SIMPLIMATIC TOOLING

is supported by solid metal from the floor up!



THE SIMPLIMATIC PLATEN TABLE rests on and against hardened and ground steel ways and gibs. It has a fast, smooth traverse to and from cutting position, actuated by pneumatic cylinders.

VERTICAL HEAD TOOLING can be arranged instead of on horizontal platen table when desired. Here, too, you have maximum rigidity and solid support for tools right to the cutting edge.

The heavy platen table of the Simplimatic automatically locks after it traverses to cutting position. Thus it and all the tooling on it become virtually one piece with the bed.

Because of the freedom in positioning slides on the big platen table, tools can be held close to their cutting edges and favored in any way desired. Moreover, this freedom from chatter is permanent because slide top is mounted on hardened steel ways and gibs.

Combined with the solidity of the cutting tools is the precision-fitted spindle of large diameter, on widely spaced roller bearings and its large herringbone drive gear mounted close to the nose. There's no chance anywhere for vibration. Chatter is *designed out!*

That's why Simplimatics can hold to extremely close tolerances, on large parts and at high production speeds. Ask for complete information about the Simplimatics.

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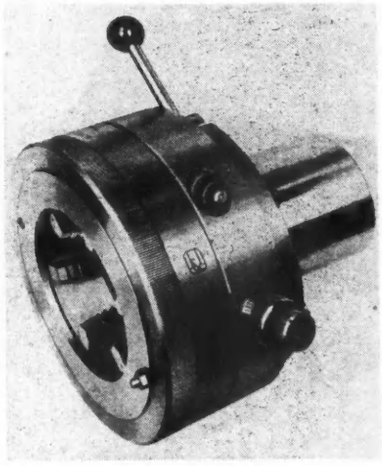
TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

New Production Equipment

(Continued from page 44)

pressure die casting machines is the straight-line hydraulic clamp used to seal the mold halves during the injection part of the machine cycle. The double acting main ram is equipped with a small internal booster ram which provides for rapid advance of the movable mold half. Just prior to mold contact, the closing speed is automatically reduced, thus eliminating slam and shock to the mold halves. The clamp pressure, clamp stroke, and position of the slow-down are all adjustable. No locking devices are required to hold the mold halves in their closed position. The machines are provided with a hydraulic knock-out in the mold clamp platen. Hydraulic pressure is also available for pulling cores automatically. Control of the H-P-M die casting machines is semi-automatic, the operator starting each cycle by means of an electrical foot switch. The balance of the cycle is automatic, however, manual controls are provided for operating each unit independently.

THE JONES & LAMSON MACHINE CO., Clinton St., Springfield, Vt., has brought out a new "High Speed" Series (radial chaser type) automatic self-opening die head. This die has a threading capacity range from 2½ inch to 4 inch for heavy duty threading and up to 4¼ inch for 8 pitch threads and finer. It is hardened and ground on all working surfaces. The chasers are ground in the thread form after hardening and hold lead correct within .001 inch per inch. The accuracy of the form, as well as the correctness of

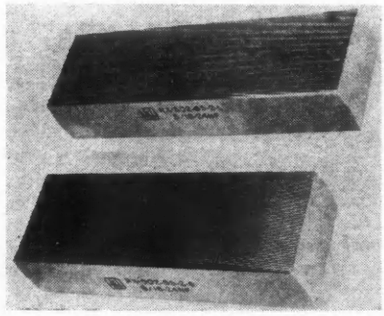


Jones & Lamson automatic self-opening die head

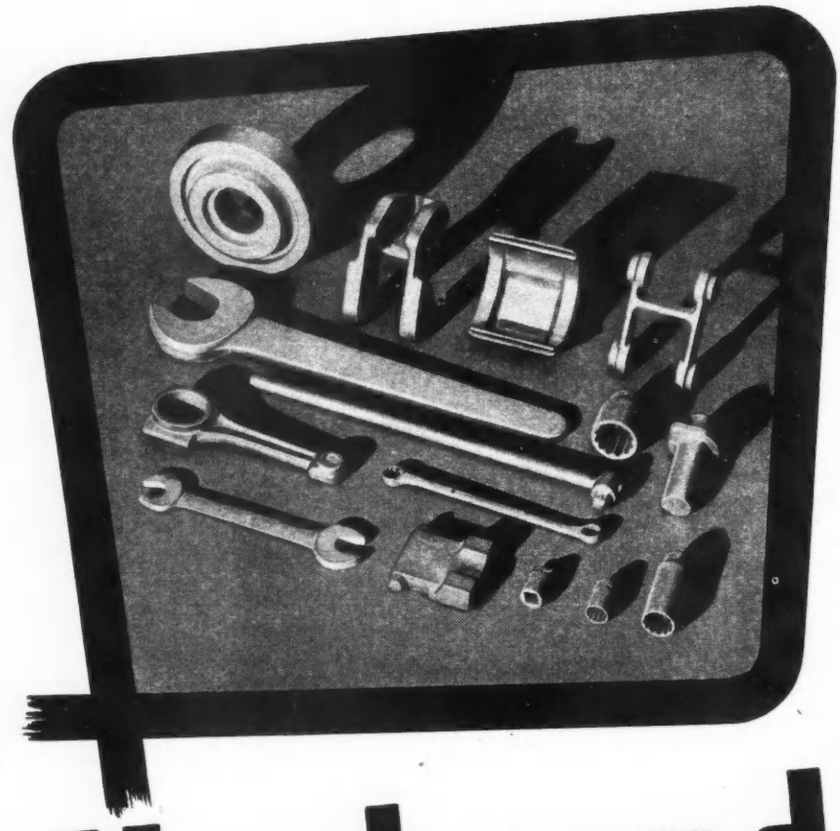
the lead, will produce threads to specifications of Class 3 fit, American National Standards. The built-in, eccentric float combined with longitudinal float is said to make it a very satisfactory threading tool for heavy saddle type turret lathes.

The company has also added ground thread flat rolling dies to the products of its manufacture. These dies are for use on Waterbury Farrell, Manville, National Bolt Maker, and National Electric Jr., and Sr. thread rolling machines. The present maximum length of these ground thread dies is equivalent to No. 40 Waterbury Farrell or 10 inch and they can be supplied in any width up to 8 inches. A standard type of starting and leaving end has

(*Turn to page* 100, *please*)



Jones & Lamson ground thread flat rolling dies



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any size or shape
up to 200 lbs.

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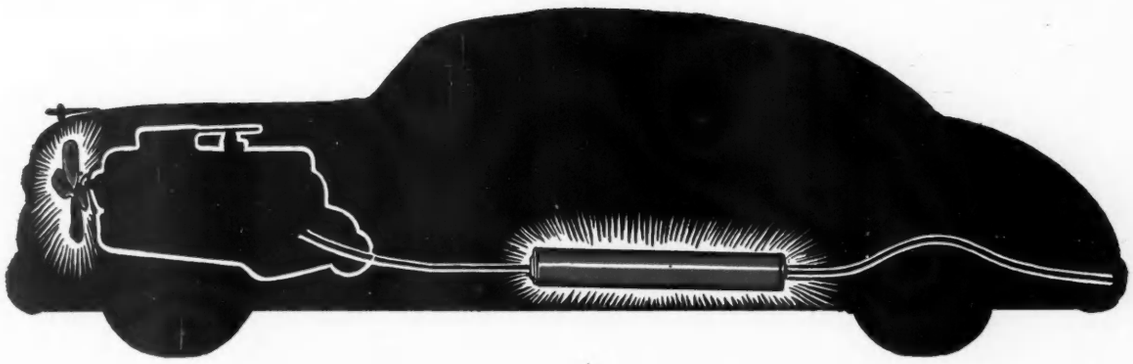

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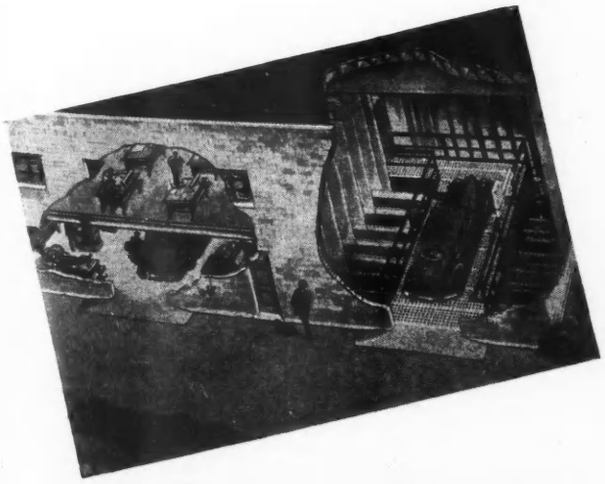
OF THE COMBUSTION PROCESS

. . . *from fan to muffler* . . .

efficient work and silent results give added competitive sales value to Hayes-equipped cars and trucks.



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Only one of its kind in the automotive industry, our new SOUND and WIND TUNNEL LABORATORY is another asset to the industry. Sound levels reaching both above and below human audible ranges are researched for fan and muffler improvements in keeping with new car and engine design.

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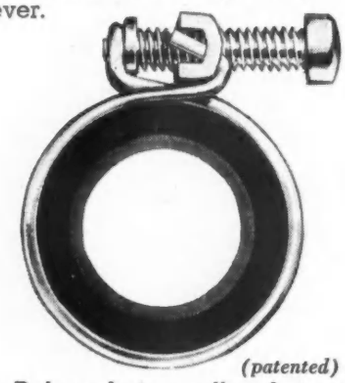
. . . the way the new Central "360" Wire Clamp Hose keeps its vise-like grip on any type of hose. It's made to "hold-on" to the last mile on the speedometer. Clamps completely around the hose . . . can't be loosened at any point of contact by jolt or vibration.

Manufacturers, mechanics and owners can now kiss their "leaky-hose-troubles" goodbye forever.



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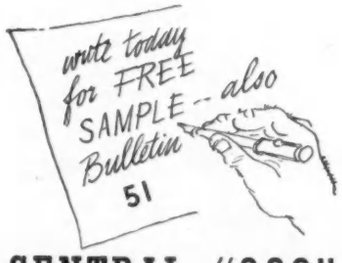
Before being offered to the trade, the Central "360" Wire Hose Clamp was subjected to every conceivable test . . . for every possible application. RESULT . . . it's unconditionally guaranteed. Costs no more. Worth much more.



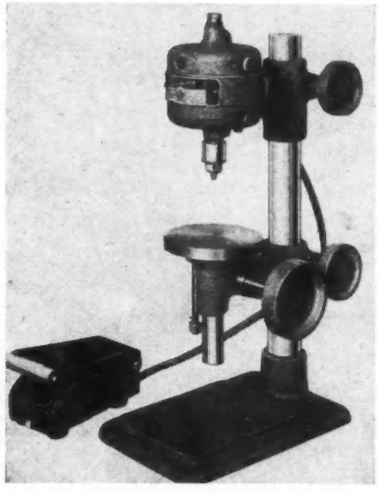
CENTRAL "360"
WIRE HOSE CLAMP
CENTRAL EQUIPMENT CO.
900 S. WABASH AVE., CHICAGO 5, ILL.

been established for the short die. This and the thread form are ground into the die in one operation on thread grinders built especially for this kind of work. All dies are matched, and the elimination of shims speeds up set up time.

DESIGNED particularly for use in the fabrication of small parts of metal, wood or plastic, a lighweight, high-speed bench drill is now in production at the Dunmore Co., Racine, Wis.

The drill head is held in the desired position on the polished solid steel column with a locking device. It rigidly holds the motor in place, yet permits vertical adjustments and a 360-deg. radius of action. The table is mounted in like manner.

Drilling operation is accomplished by elevating the table to the drill through the use of a hand control geared to the table. This feature is said to be an advantage in getting the proper work-



Dumore high-speed bench drill

feeding speed. Power is supplied by a 1/30 hp motor with a range of 2,000 to 15,000 rpm. Speed is controlled by a foot rheostat, permitting free use of both hands for the drilling operation. Capacity is ⅛-in. drills and smaller.

FOUR-SECOND fire fighting is said to be possible with the new fog unit just placed in production for industrial and institutional use by Bowser, Inc., Fort Wayne, Indiana.

An entirely new product by Bowser, the fog fire fighting units are being built in two models, the only difference being that Model 1030 has a shorter hose and smaller cabinet than Model 1033 which has 100 ft. of one-in. hose.

The unit is connected directly to a water line. A swing-joint mounting on the wall or a stand pipe makes it possible for the cabinet to revolve in alignment with the direction of the hose pull.

A valve actuating fixture holds the fog nozzle for instant use and fog appears at the nozzle within four seconds after reaching for the hose.

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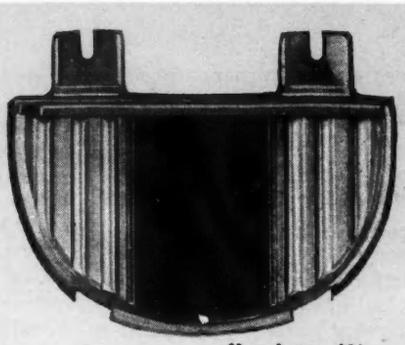
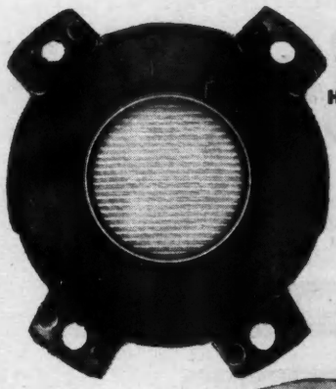
You'll soon be seeing in large numbers the cars that wear the parts of "Lucite" shown here. Nearly all cars today use "Lucite." It's a mark of distinction and quality. It typifies the American's pride of ownership in his automobile.

As to the other important reasons why new car designers choose "Lucite" acrylic resin for so many parts where beauty counts heavily . . . where lasting service is a "must"—a glance at the list of the properties of "Lucite" in the panel below will tell you much.

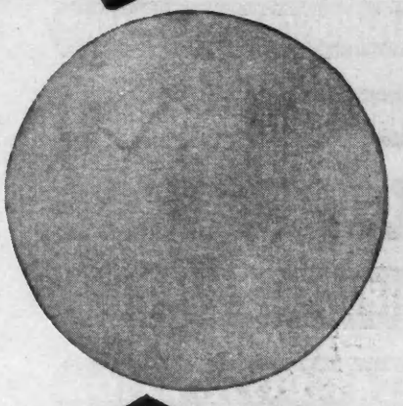
For "Lucite," either in its clear transparent form or in rich colors of your choice, not only has outstanding beauty on the sales floor, but has the stability, shatter-resistance, and weathering qualities which assure high value, years and years later. Also, the ease and speed of molding "Lucite" often cut production costs. Write today for booklet *Heat-resistant "Lucite."* E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept., Room 205, Arlington, N. J.



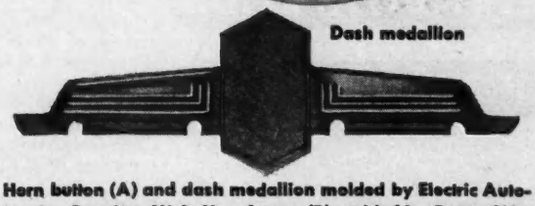
Horn button (A)



Horn button (B) another style



Clock crystal



Dash medallion

Horn button (A) and dash medallion molded by Electric Autolite Co., Bay City, Mich. Horn button (B) molded by Cruver Mfg. Co., Chicago. Clock crystal molded by G. Felsenthal, Chicago.

You'll find "LUCITE" in the new cars because

- ★ "Lucite" has outstanding resistance to sunlight, to many chemicals, to "weathering."
- ★ "Lucite" has a favorable strength-weight ratio.
- ★ "Lucite" is crystal-clear, highly transparent.
- ★ "Lucite" has good shatter-resistance, good tensile and flexural strength.
- ★ "Lucite" has the remarkable property of "edge-lighting."

DU PONT
REG. U. S. PAT. OFF.
Plastics
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

Scintilla's Self-Contained Setup

(*Continued from page* 42)

Tumblers and burnishers are of the following makes: Roto-finish tumblers, Lupomatic tumblers and Abbott burnishers.

Quality Control

The quality control program merits special attention. Because of its background of aircraft manufacturing, the company has always relied upon rigid control of every phase of the operation. And the same philosophy has carried through on products made for industrial and commercial applications.

What makes the present system so interesting is the adoption of statistical quality control methods in the machine shop. Scintilla has developed simple procedures which have eliminated many 100 per cent inspection operations and have reduced product inspection on an average of 30 per cent. All of this is credited to a practical application of the quality control technique. Both quality control and inspection are under the direct supervision of the quality manager who reports to the general manager, thus placing their operations completely out of the jurisdiction of any other department head.

Quality control is divided into three distinct functions—product inspection, process inspection, process investigations. Product inspection implies the normal methods of gaging and checking so as to segregate acceptable and non-acceptable parts. But process inspection is a new concept. It constitutes the basic method of quality control by the use of the control chart for each machine, parts inspection being done on a sampling basis while the machines are running. The sampling inspection of parts actually results in control of machine condition and tool setup rather than an inspection of the product. This is based on the underlying theory that if the machine is in good condition and if the setup of tools and fixtures is right, the product must come within the established tolerance limits. Such variations as may occur then are the result of a change in machine conditions, or due to wear or breakage of tools.

Process investigation, a direct result of process inspection determines when the process is out of control, the reasons for lack of control, and a decision as to the corrective action to be taken.

Quality control also encompasses such necessary work as investigations of customer complaints, investigations of field complaints or test failures and the keeping of records and reports as an index to show the effectiveness of its own operation. Additional functions of the quality control department are: Gage and equipment follow-up, supplier liaison, specification investigations, technical investigations, training for inspectors, method analysis and motion study as applied to inspection, inspection planning, and coordination with other departments.

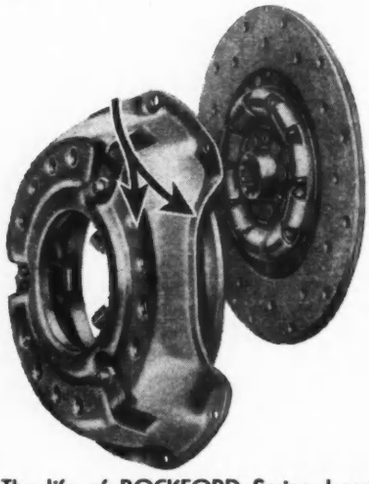
Statistical techniques have done much to adjust and put inspection where it is needed. When final inspection is made by sampling the product, the procedure is outlined on an inspection routine sheet. Sample size, lot size, and allowable number of defects are incorporated as a part of this routine. Figures relating to the correct sample size for each respective lot are taken from the Dodge-Romig table. Quality levels are established by using, as a basis, the information given in previous inspection reports and the importance of the part.

Control charts at the machines have proved an efficient means for bringing about corrective action. The use of charts has been instrumental for carrying out investigations, keeping proc-

(*Turn to page* 104, *please*)

Specify ROCKFORD —SPRING LOADED— for CLUTCHES

LIGHT PEDAL PRESSURE
CUSHIONED ENGAGEMENT
VIBRATION DAMPENING
ACCURATE BALANCE
DIRT EXCLUSION *
HEAT DISSIPATION
LIFETIME ADJUSTMENT



* The life of ROCKFORD Spring Loaded CLUTCHES is lengthened by the design of their cover plates. This feature provides maximum ventilation for the clutch. The openings in the top and sides supply a flow of air that promotes cooling and the escape of dirt and dust from the clutch. This life-lengthening cover design is just one of several ROCKFORD advantages.

SEND FOR THIS HANDY BULLETIN ON POWER TRANSMISSION
It shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications. Every production engineer will find help in this handy bulletin, when planning post-war products.

ROCKFORD CLUTCH DIVISION BORG-WARNER
315 Catherine Street, Rockford, Illinois, U.S.A.

WHAT'S THE LIMIT?

No human has ever climbed to the top of Mt. Everest and returned to tell the tale. Is this the mountain man will never conquer?

IS *Porous Chrome** THE ENGINE-LIFE PISTON RING?

We can't give you the final answer to that important question. But 7,000,000 miles of road tests did show that Porous Chrome piston ring sets may last for the life of the engine!

The secret seems to lie in the fine honing action of the chrome ring when first installed. It seats the entire set in the first hour—eliminates the excessive wear of a normal break-in—multiplies ring life by four or five times—halves the wear on the block.

If you are interested in substantial maintenance savings, call your American Hammered jobber without delay. Porous Chrome sets for bus and truck engines are ready now.

ANOTHER
American Hammered
RING LEADER

Chrome piston rings are an original American-Hammered development

* Van der Horst process

Koppers Company, Inc., American Hammered Piston Ring Division, Baltimore, Maryland

American Hammered Piston Rings

A KOPPERS PRODUCT

(Advertisement)

HANGAR FLYING

LOCKHEED

The Wreckers

If you ever want to tear a wing off an airplane, check with the men in the Structures Lab at Lockheed's Factory B-1 in Burbank. These boys are experts.

Not long ago their entire career consisted of deliberately ruining the meticulously engineered assemblies that went into the *Constellation*, just to see if the parts came up to Lockheed's exacting standards.

For instance: they took up number 61 (the first *Constellation*), blew a hole in one of the two tires on the nose landing gear, and then brought the plane in at 80 mph. The *Constellation* landed nicely.

Another time these testers purposely threw dirt and water into the oil lines of the hydraulic booster system, forcing it to work under what they understate as "adverse conditions." Adverse, that is.

They even kicked around a whole tail control assembly in a chamber that was 70 degrees below zero (Fahrenheit) until all the low-temperature bugs had been licked.

As a result of this kind of highly creative destruction, which goes on at Lockheed year in and year out, the *Constellation* is the most advanced and safest transport in service today.

L to L for L

©1946, Lockheed Aircraft Corp., Burbank, Calif.

esses in control, and eliminating many 100 per cent inspection operations. Putting the emphasis on the process has reduced product inspection 30 per cent. For parts produced on automatic machines, final inspection of the operations is done at the machines. Samples taken every half hour by the process inspector assure quality acceptance. This procedure has facilitated a group bonus plan for operators, since the pay-off can be made immediately.

Summaries of control charted operations and parts inspected by product and receiving inspection are compiled by the quality control group.

Which Way, Americans?

(*Continued from page* 15)

The second principle is doctrine that has long been preached by radicals. Not until the New Deal, however, was it ever sponsored by accepted American leaders. The second principle can apply only in a class society. The New Deal created classes, the "Haves," and the "Have-nots." It told the American people that the way to national prosperity was through political action that would force the "Haves," who—according to the New Deal—owned and controlled the great bulk of the country's wealth, to provide more jobs and pay higher wages for less production. Now this was advice that would be readily accepted by the ignorant and shiftless at any time. It undoubtedly would not have been accepted, as it was, by so many Americans, except under the prevailing conditions of the most serious depression in the history of our country. The idea of political action to change our system was sold by the largest, highest-pressured, most continuous, and most costly propaganda campaign ever known. It was endorsed by labor unions and politicians. It was grafted into the teachings of many of our churches and schools.

Unless the American people act soon to secure a basic change in the philosophy and methods of Federal Government, our country will find itself at the dreary end of the road we have been travelling. The end of that road is Statism which, in one form or another, has engulfed most of the countries of the world.

What is to be done about this very serious situation? We have only one hope. That is to return by the shortest route to government based on the American principles of individual freedom of thought and action. Americans must reaffirm their determination to make their own important decisions in life and their willingness, as individuals, to accept the responsibility for those decisions. Individuals must again look to their own efforts and their own work for their own advancement, and not hope to gain special advantage through political group action.—*From an address before the Detroit Section, S.A.E.*

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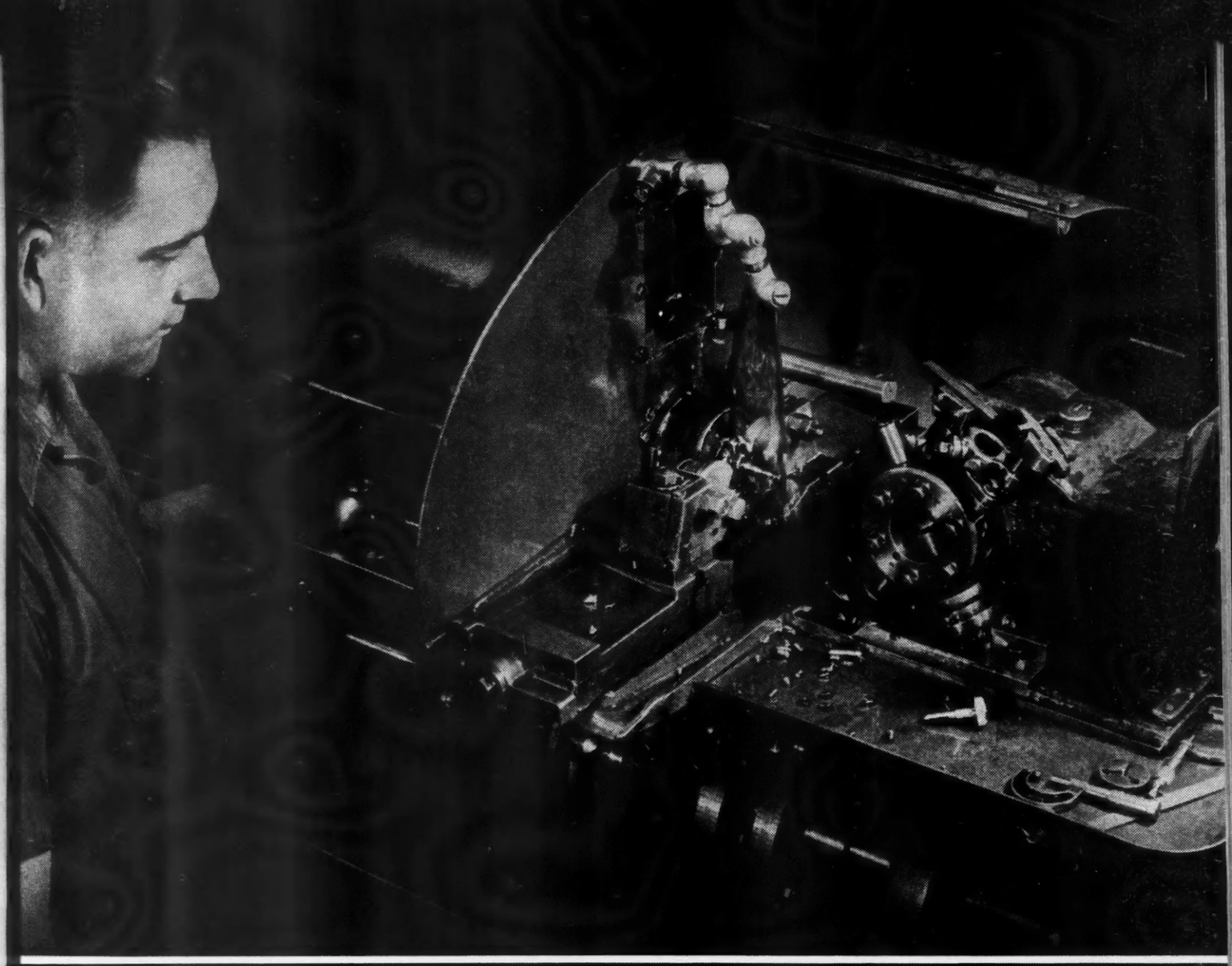

TOOL LIFE *Up 400%*

SUNICUT...

Increases Production from 75 to 380 Pieces per Grind

A manufacturer of automotive parts formerly obtained from 20 to 75 pieces between tool grinds and was troubled with high drill-breakage.

Changing to Sunicut, for a cutting lubricant, he was able to increase tool life more than four hundred per cent—to 380 pieces per grind.

This is a typical example of the way in which Sun Engineers lend a helping hand to the manufacturer who is striving for production . . . precision . . . and profits.

And Sun service is not limited to machine shops. Throughout industry . . . in steel mills, textile mills, chemical plants, power plants . . . in the processing of rubber, ink, leather, paint . . . the Sun trade-mark and the Sun Engineer stand for higher production at lower costs.

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SUN
SUNOCO
INDUSTRIAL PRODUCTS

Dynamometer Testing of Aircraft Model Motors

(*Continued from page* 33)

Precision Instruments

In order that electric measurements taken would correspond to accuracy of other wind tunnel model testing, the electric metering devices have a repeatable accuracy of 0.5 per cent on duplicate readings for any given condition provided the reading is above 30 per cent of the instrument scale. Calibration curves were taken on the instrument transformers as well as on the meter instruments themselves in order that this accuracy may also be absolute accuracy. Through the use of multi-range instrument transformers all readings can be taken at nearly full scale conditions. This insures full scale accuracy under all conditions. The multi-range transformers are a set of current transformers with eight different ratios of primary to secondary current, covering a range of 600/5 amp down to 5/5 amp, and a set of potential transformers with seven different ratios of primary to secondary voltages covering a range from 900/75 v down to 75/75 v.

The precision instruments are a voltmeter, an ammeter, and a polyphase wattmeter each having a face similar to an aircraft tachometer with two hands. A greatly expanded scale results, allowing easy accurate reading. Each of the units has a basic element equal to that found in the General Electric type P-3 high accuracy portable indicating AC instruments. The movement of the basic element in the units is recorded by a photo-electric circuit which drives a selsyn transmitter. The selsyn transmitter operates a selsyn receiver in the instrument face. The transmitter unit is sufficiently large to drive other selsyn receivers for use in the automatic printing of electric data.

In addition to measuring the electric quantities, amperes, volts, and watts, it is necessary that shaft revolutions be accurately measured in order to obtain complete performance on a model motor. This is handled by two precision tachometers, the instrument faces of which are located along with the other instruments mentioned above. Instrument faces of these units are essentially the same as the precision meters previously mentioned. The operating principle, however, is entirely different; only a small alternating voltage is necessary at the input to operate these precision tachometer units satisfactorily. Such a voltage may be driven from a remote tachometer alternator, the variable frequency power lines, or any photo-electric pickup capable of a voltage output ranging from 5 to 150 v. Basically the units consist of two major components; one a measuring circuit, converts the AC signal voltage to d-c voltage which is directly proportional to the frequency of the signal voltage; the other a self-balancing potentiometer which measures this d-c voltage by driving itself to a position where the basic element, a sensitive millivoltmeter, is always in a null position, indicating that the attached bridge circuit is balanced and zero potential is across the millivoltmeter element. The self-balancing potentiometer transmits its movement to the instrument face through the use of selsyns as it is driven to the balance position. Using four different ranges, one can read with an accuracy of plus or minus 0.2 of one per cent of full scale, any frequency from 0 to 1000 cycles per sec. The scale face is graduated in 1000 equal parts. Frequencies or shaft speeds may be readily determined by using the proper multiplying factors. Like the other precision instruments mentioned, these units are also capable of driving an automatic printing mechanism.

(*Turn to page* 108, *please*)

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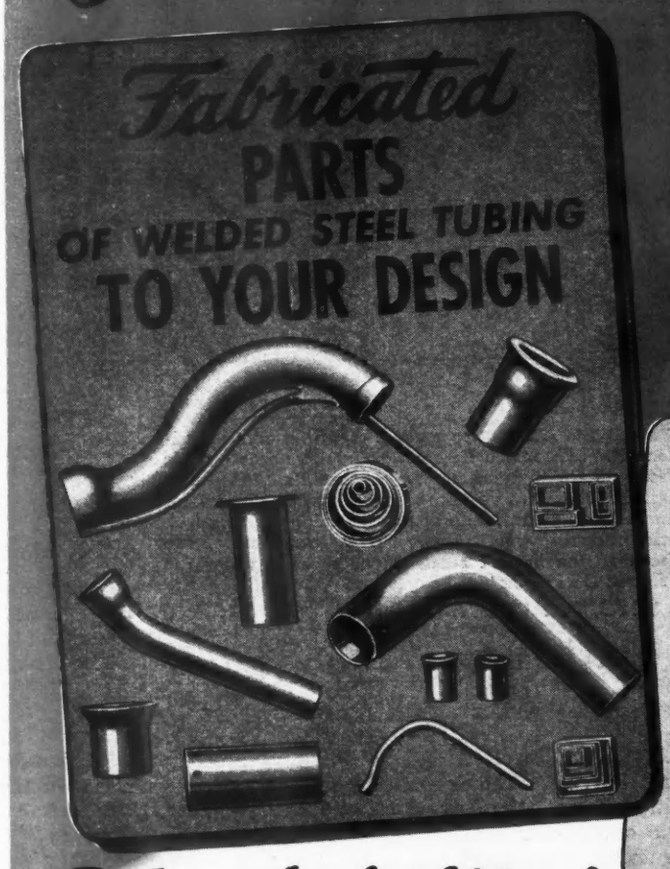
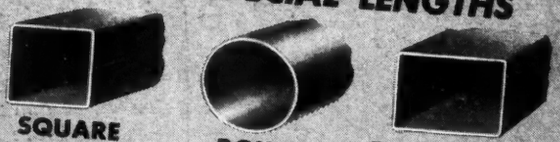
Specialists in Aluminum Permanent Mold Castings
Sterling's modern foundry, patented molding process, quality materials, and expert workmanship have been, for years, producing the finest in aluminum pistons.
This same expert workmanship and patented molding process has enabled us to develop many special permanent mold aluminum castings for the automotive and aviation industries.
Wherever a minimum of finishing and light weight is a factor, our engineers' experience will be of value to you in developing a permanent mold aluminum casting to economically meet your requirements. Call or write
STERLING ALUMINUM PRODUCTS INC.
St. Louis 6, Missouri

MICHIGAN WELDED STEEL TUBING



ROUND, SQUARE, RECTANGULAR AND SPECIAL SHAPES

- *IN COMMERCIAL LENGTH*
- *CUT TO SPECIAL LENGTHS*

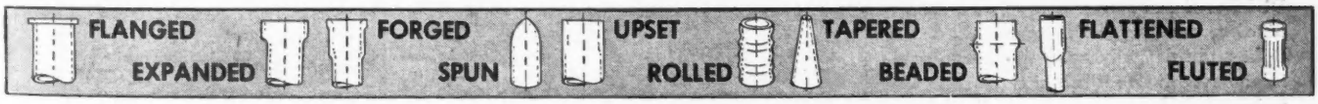


SQUARE	ROUND	RECTANGULAR
½" to 2¾" 14 to 20 gauge	¼" to 4" O. D. 9 to 22 gauge	½" to 2¾" 14 to 20 gauge

Adaptability!

Michigan Welded Steel Tubing is available in sizes and shapes that make it readily usable in the production of a wide variety of parts.

Whether you form and machine the parts in your plant or order them prefabricated by Michigan, you will find this tubing exceptionally uniform in structure and adapted to reworking by any production process. Michigan welded tubing can be:



Engineering advice and technical help in the selection of tubing best suited to your needs. Address your inquiries to:

Michigan STEEL TUBE *PRODUCTS CO.*

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COLD SPRAY-GRANODINE produces a dense smooth zinc phosphate coating that protects steel and paint for a durable, lustrous paint finish.

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DURIDINE 210 B (formerly 210 B Deoxidine) assures proper cleaning and a thin, tight and relatively hard phosphate coating so essential to a bright enduring paint finish.

DEOXIDINES — Phosphoric acid metal cleaners. Remove rust and rusters and prepare metal surfaces properly for lasting paint finish.

LITHOFORM — a phosphate coating that bonds paint to galvanized, zinc or cadmium coated surfaces.

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Equipment making use of an electrified bookkeeping machine is in the design stage and will be used ultimately with the above and other instruments. This will enable automatic printing of a record sheet on any model motor runs or dynamometer test runs.

At the control desk which is the center of operations of both model motor test runs and dynamometer tests, the operator will have before him the following instruments of the precision type already discussed:

One a-c voltmeter with a 0 to 75 v scale and a handy range selector switch giving multiplying factors from 1 to 12.

One a-c ammeter with a 0 to 5 amp scale and a handy range selector switch giving multiplying factors from 120 to 1.

One polyphase wattmeter with a 0 to 650 watt scale and range multiplying factors of 1 to 1440 due to the current and potential range selector switches mentioned above.

Two electronic tachometers each with ranges available for 0 to 100, 0 to 500, and 0 to 1000 cycles.

One volt per cycle meter with scale showing 0 to 4.0 volts per cycle. This instrument is not of the precision type but it is of great use in setting the control of automatic volts per cycle regulation on the converters A and B. Model motors are very critical as to the volts per cycle at which they are run and consequently require that the volts per cycle be maintained at a constant value during a test run.

Farmall Cub

This new Farmall Cub tractor is in the preproduction stage at the International Harvester Co. It is powered by a four cylinder 10 hp gasoline engine. The wheelbase is 67.5 in., the length overall 96 in., and width overall 42.5 in. (minimum). Clearance under the chassis with standard tire equipment is 19 in.